THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVI. No. 1698.] LONDON, NOVEMBER 26, 1895. [47TH YEAR. PRICE 6d.

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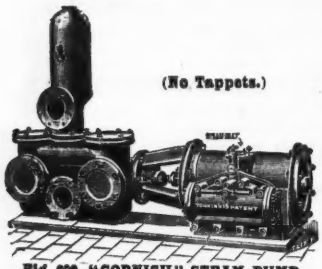

Fig. 600. "CORNISH" STEAM-PUMP FOR WATER.

TRADE MARK.

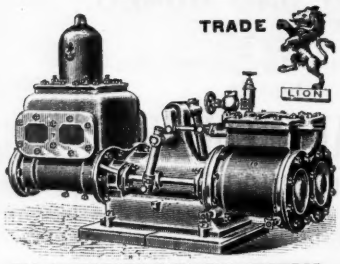

Fig. 670. DUPLEX PUMP FOR GENERAL PURPOSES.

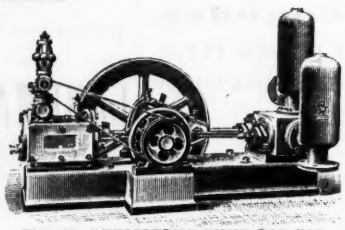

Fig. 685. "RELIABLE" PUMP FOR TAR AND THICK FLUIDS.

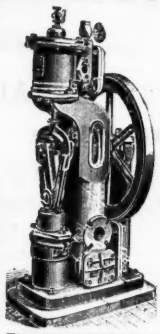

Fig. 705. SINGLE RAM PUMP FOR BOILER FEEDING, &c.

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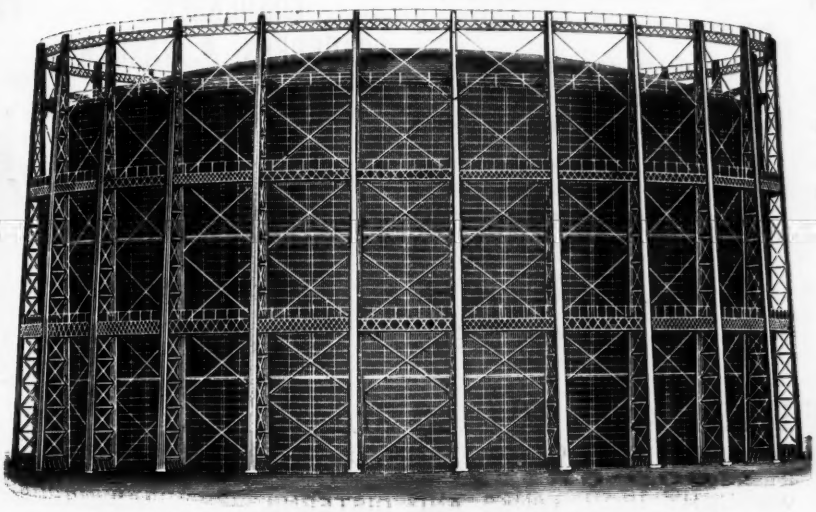

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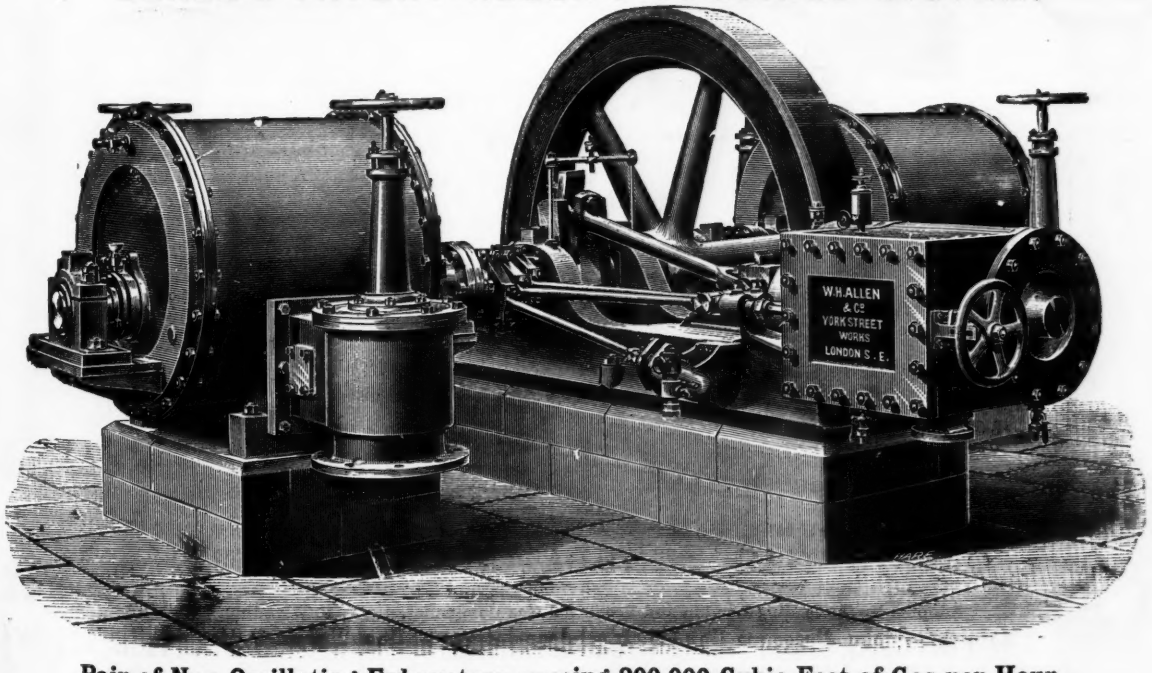

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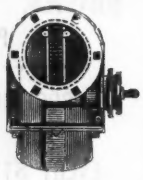

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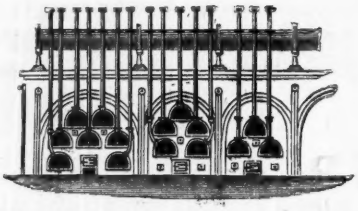

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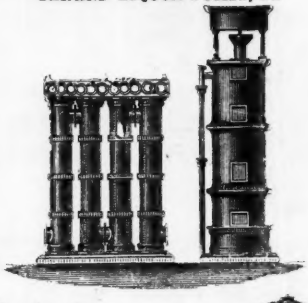

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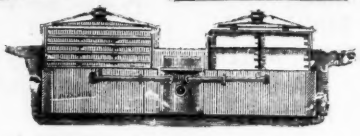

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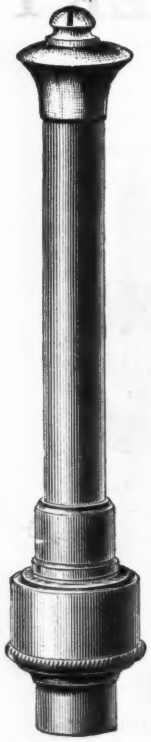

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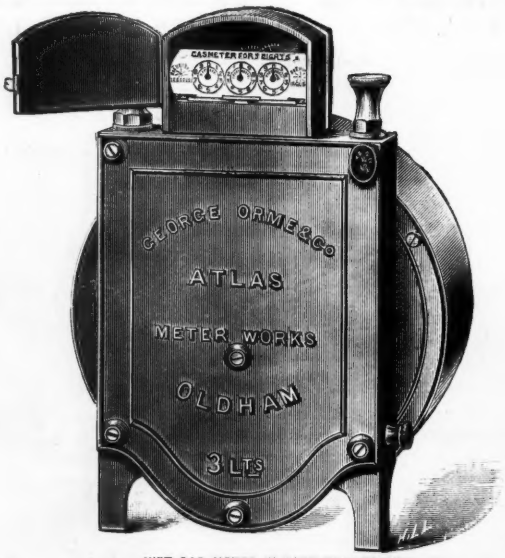
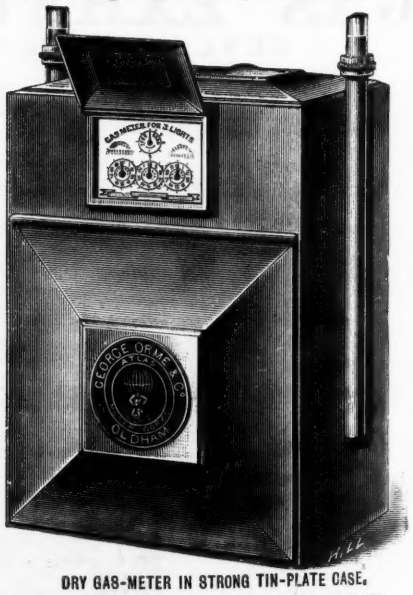


WET GAS-METER IN CAST-IRON CASE.



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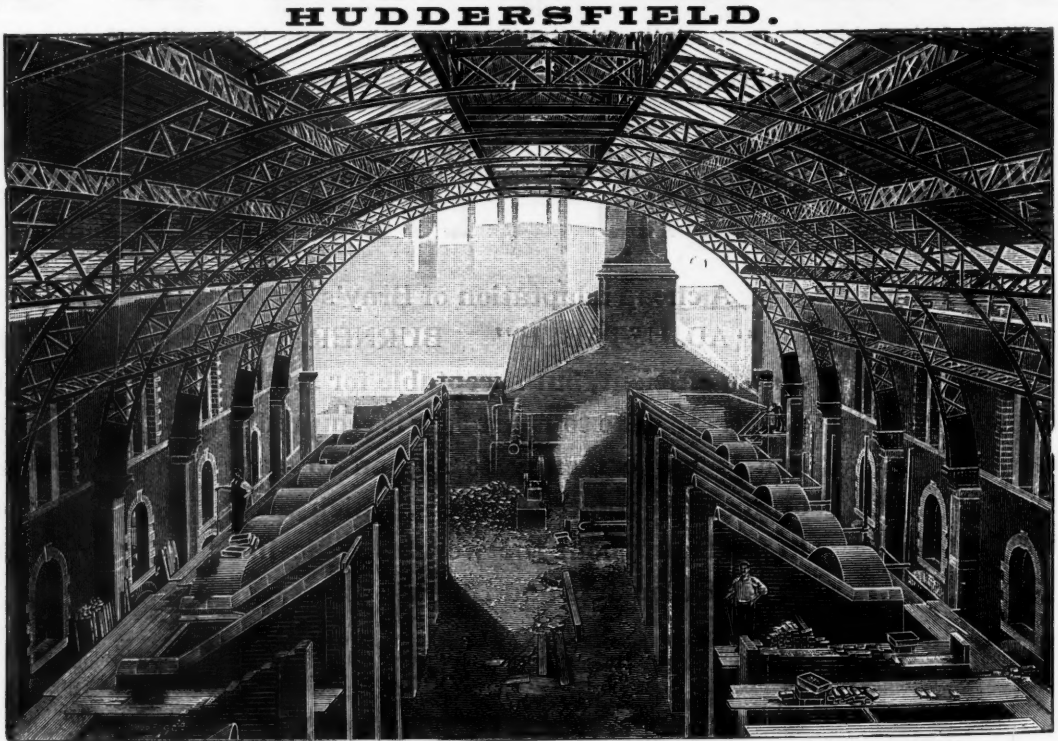

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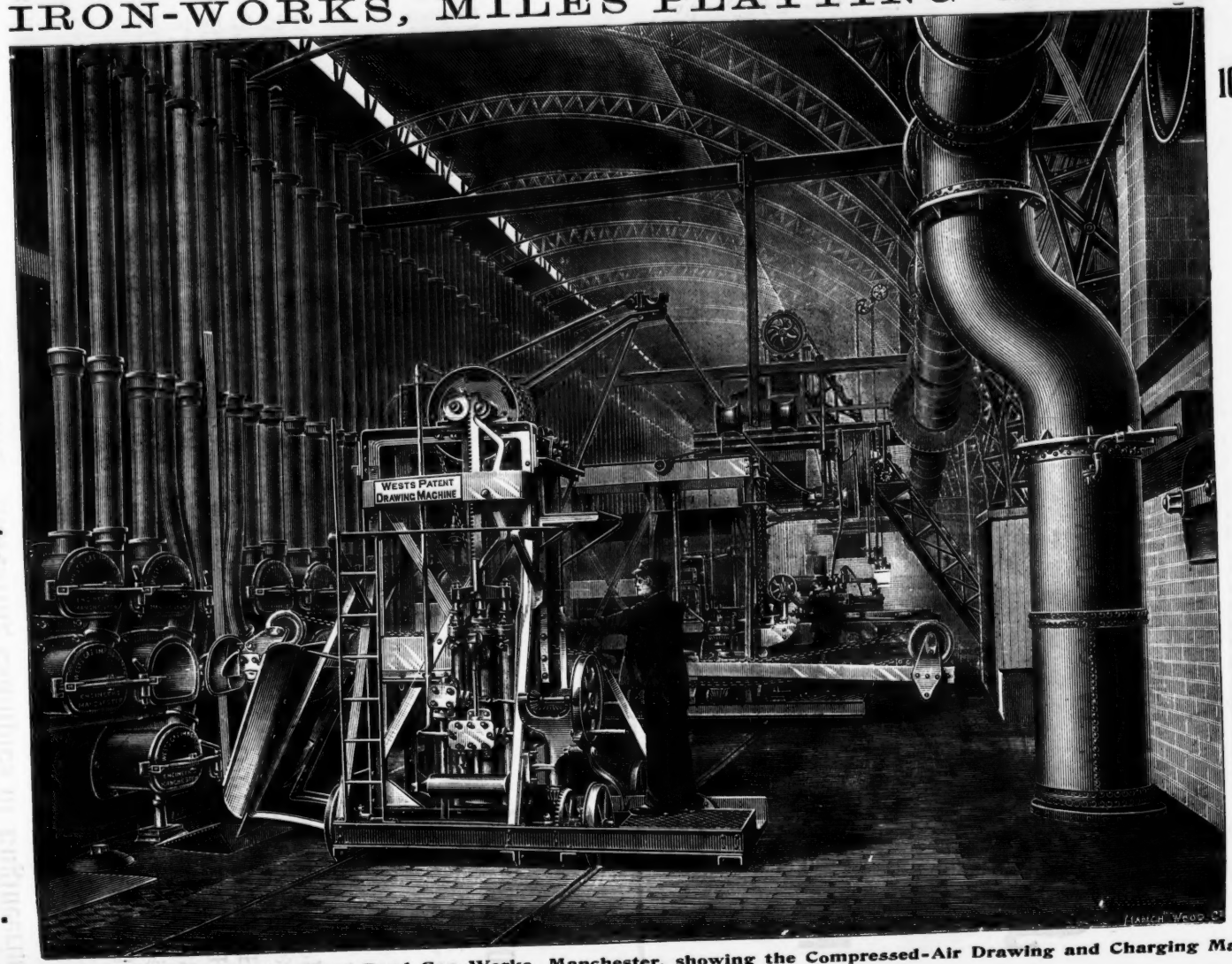

Interior of Retort-House at the Bradford Road Gas-Works, Manchester, showing the Compressed-Air Drawing and Charging Machines.

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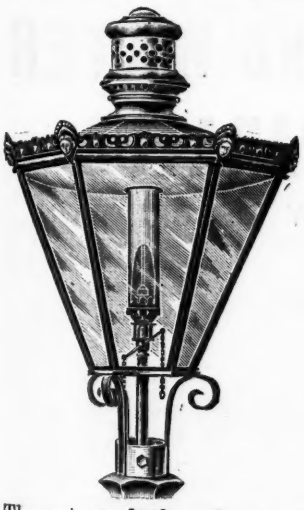

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The estimated quantity of gas that would have been consumed by the 10-feet flat-flame burner was 11,678 cubic feet. The actual quantity of gas used by the Incandescent Gas-Light Company's Burners, as recorded by the meters, was 4415 cubic feet.
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(2) The illuminating power given by the Incandescent Gas-Burners, consuming 3·78 cubic feet of gas per hour, was found to be equal to 60 candles. That given by the flat-flame burners, consuming 10 cubic feet of gas per hour, was 26 candles.
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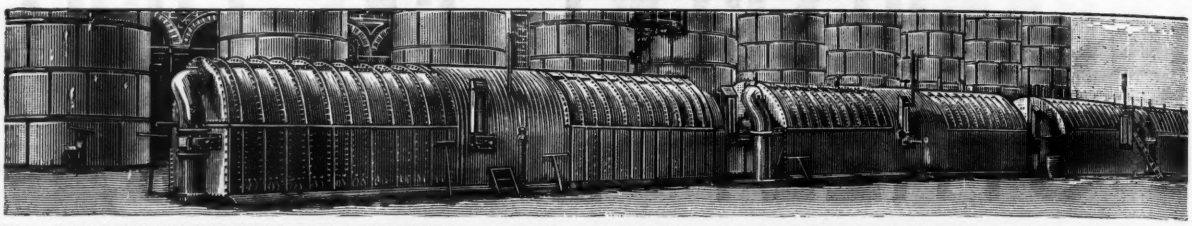
☛ **504** of these Machines (capable of dealing with **491,150,000** cubic feet of Gas daily) in use and in course of construction, which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



View of SIX PATENT "STANDARD" WASHER-SCRUBBERS, erected at the Beckton Station of The Gaslight and Coke Company (the Engines driving same being under Galvanized Iron Covers). This Company have 30 of these Machines in use. They are also in operation at a great number of Gas and other Works in this Country and Abroad.

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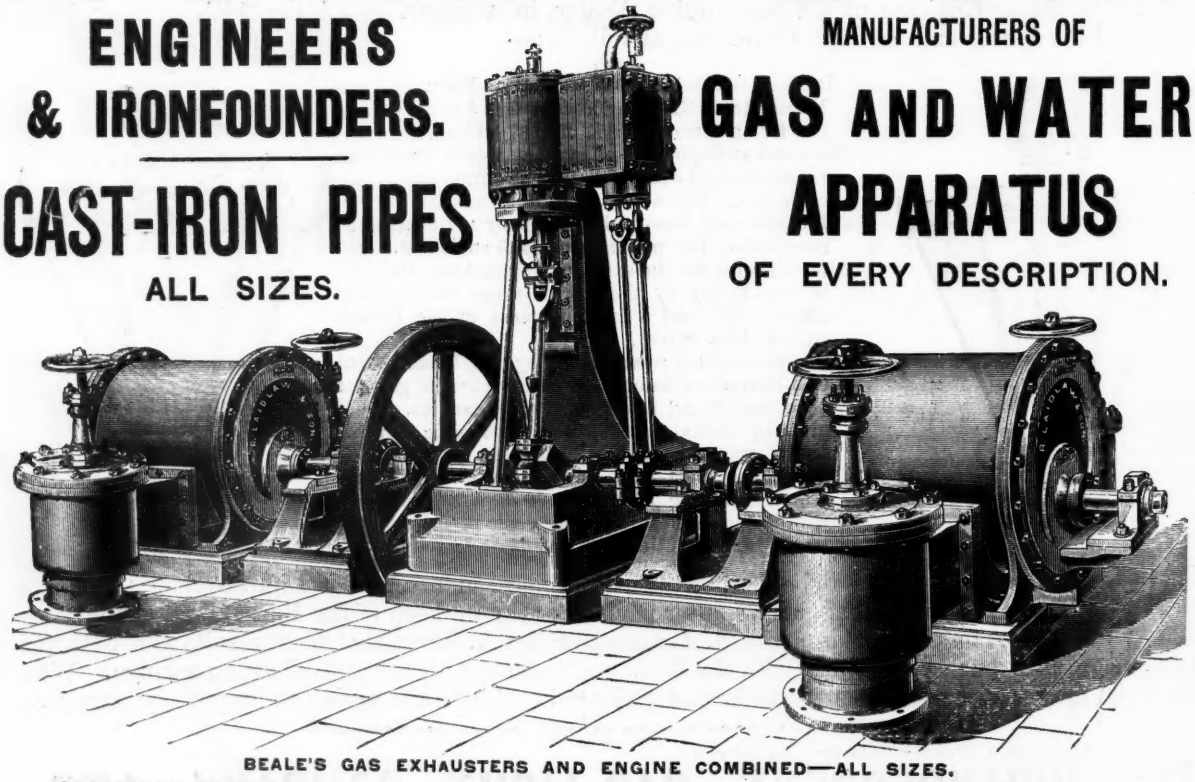

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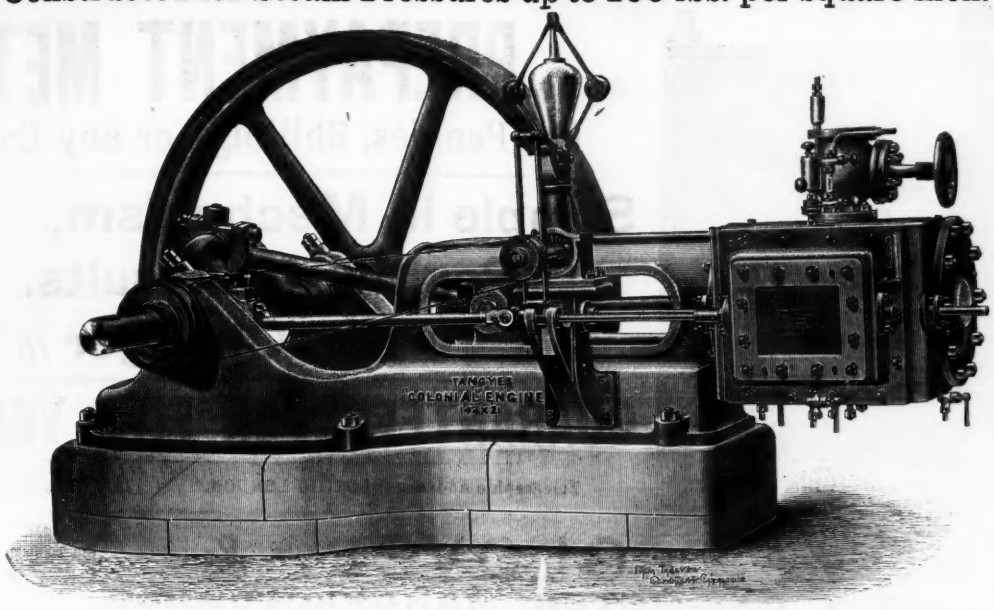

Tangyes' "Colonial" Steam-Engine, with the TANGYE-JOHNSON PATENT AUTOMATIC CUT-OFF GEAR. From a Photograph of the 14½ in. by 21 in. size.

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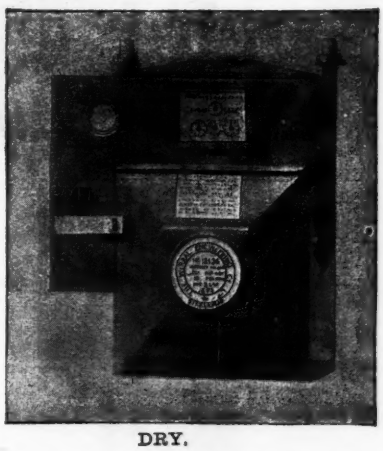

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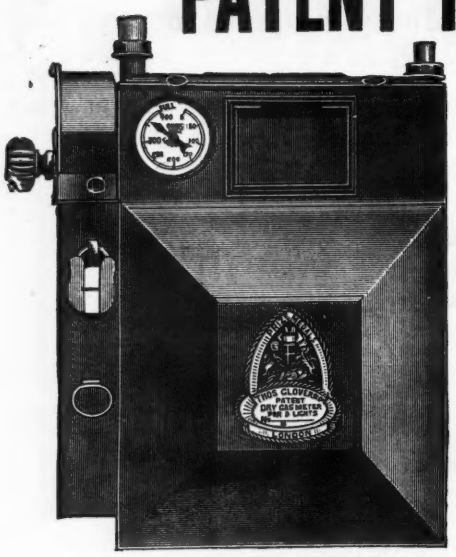

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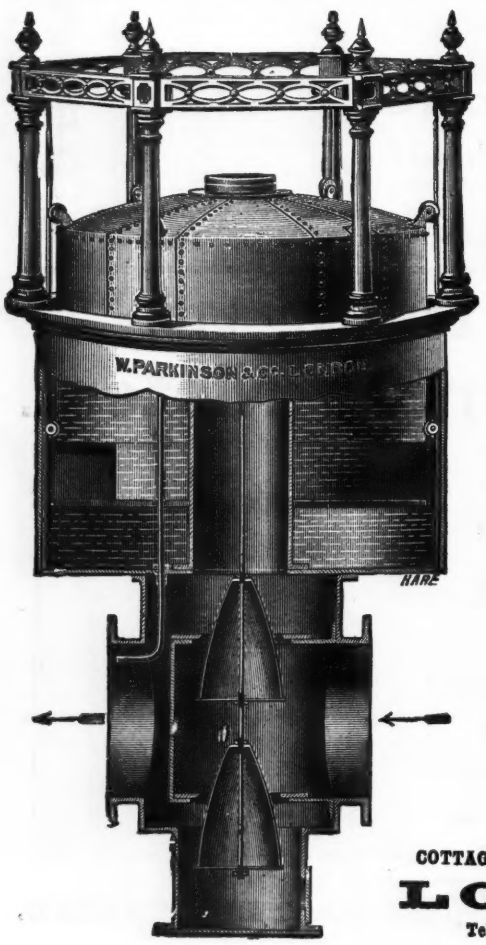

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TO CORRESPONDENTS.

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EDITORIAL NOTES.

The Parliamentary Notice for the South Metropolitan Bill.

FIRST of all the parliamentary notices for next session, we have to draw attention to that issued by the South Metropolitan Gas Company, who intend to reintroduce, with some not unimportant modifications, their dropped Bill of last session—this time with the famous workman-director clause in its appointed place. The notice covers the conversion of the whole capital of the Company into a uniform consolidated 4 per cent. stock, and the similar conversion of the existing 5 per cent. debenture stock into a substituted stock bearing interest after the rate of 4 per cent., or such other rate as may be defined by the Bill or prescribed by Parliament. The Bill is to make provision "with respect to the investment by persons in the employ "of the Company in the capital of the Company, and for "their representation in or upon the management of the "Company." Provision is also to be made for the offering of new stock to consumers at the market price; for the extension to certain stockholders of some of the provisions of the Savings Bank Acts; and for effecting one or two other objects of minor importance. There is, of course, no news in this notice, which was inevitable, except the change of the proposed new uniform standard rate of dividend from 5 to 4 per cent. The alteration is a decided improvement, as bringing the nominal rate of dividend into close accord with the return which an investor in the Company's stock would actually receive—this being the idea of the proposed stock operation. We suppose there is good reason for making the proposed converted debenture stock bear a 4 per cent. rate of interest (nominal); but seeing that, as a matter of fact, it does not return 3 per cent. to the purchaser, and bearing in mind the custom which makes debenture stock carry a lower rate of interest than the stock which supports it, it might be thought that the new South Metropolitan debenture interest would be 3 per cent. only. It is too late in the day to argue that the undertaking will benefit by the abolition of its high-priced stocks, and the substitution for them of a uniform low dividend-bearing stock of only one denomination, value, and rank. This is understood and conceded on all hands. Nor is it much more to the point to argue about the other leading proposals of the Bill. It is to be hoped that, when the Bill is committed, it will be to a Committee too strong to be frightened by an opposing Counsel. Mr. Worsley Taylor, Q.C., did this last time on behalf of the London County Council; and he did it very well, as we acknowledged at the time. There is another Parliament now, and also, to all intents and purposes, another County Council; so that the opposition tactics of last session could hardly be hopefully repeated. All the same, it is to be trusted that the Committees before whom the new Bill will come in due course, will be strong and courageous; for the Bill deals with issues of the first importance to the Metropolis, to the public of small investors, and to the well-wishers of labour. It is quite true, as Mr. Worsley Taylor put it last session, that the consolidation and conversion of a Metropolitan Gas Company's stock is a business evoking other considerations than such as attach to the performance of the same operation by a Suburban or a Provincial Gas Company; but if the thing is good anywhere, it is likely to be at least as good for London. Again, the case of the small investor—be he gas consumer or not—is sure of a sympathetic hearing from the new House of Commons. In opposing this part of the Company's scheme last session, the London County Council were blindly fighting for the autocrats of the Stock Exchange—a mistake which is not likely to be repeated next year. The measure, of course, will hang together, and must be taken or left as a whole. Every reader of the JOURNAL who is solicitous for the advancement of gas company administration will wish well to this particular measure, even though all its projects may not command universal admiration. It represents a policy of progress, in the proper sense of this greatly-abused word; and progress stands for life, as inaction invites and predisposes to decay.

The Cause of the Strand Explosion.

As will be seen by our special report of the proceedings at the adjourned inquest on the fireman who came by his death in consequence of the Strand gas explosion on the

29th ult., there is no longer room for any doubt as to the cause of this deplorable occurrence. The man died from injuries accidentally sustained while doing his duty in searching the ruins of a house which was wrecked by the explosion of a mixture of coal gas and air that had accumulated in the closed basement storey. The gas came from a fractured main passing in front of the house, underneath the pavement of the court towards which it faced. The main was laid in 1879, at a depth of about 2 feet from the surface; and in all human probability it would have remained sound and in good serviceable order for many years to come, had it not been for the circumstance of the supporting earth being washed from under it by a leakage of water from a broken water-main which ran within a foot of it. The escape of water showed itself in a neighbouring cellar; but no injury to the gas-main was either noticed or suspected, even by the Water Company's workman who attended to the leaky water-main. Subsequently, however, a smell of gas was perceived in the vicinity; and the usual measures were being taken for dealing with this sign of something being wrong when the explosion took place. There was plenty of evidence to show that the effect of the escaping water upon the subsoil that should have supported both the gas and water mains was extensive; that the gas-main had newly cracked under the strain thus brought upon it; and that there was every facility offered in the practically closed and uninhabited cellar or basement storey of the wrecked house for the unnoticed accumulation in large quantity of an explosive mixture due to the infiltration into this empty space of gas from the fractured main. These are all the elements needed to account for the explosion; and the Coroner's inquiry could not therefore terminate otherwise than as it did—with a verdict exonerating the Gas Company and everybody else from blame in respect to the disaster. This is completely satisfactory, so far as the personal question is concerned. The other question, of who is liable to pay for the damage to property, apparently remains open.

Contemplated Gas-Works Transfers.

Measures are being taken, both in Derby and Cheltenham, having for their object the acquisition of the gas undertakings by the Corporations. In neither case can such a movement be deemed surprising; for both concerns are first-class properties, such as any local authority might be glad to possess. Excellence of this kind must be paid for; and it is quite possible that, when it is made known upon what terms the proprietors of the undertakings in question would be willing to relinquish their interest, the local authorities will indulge in reflections as to the price at which even gold becomes dear. The Cheltenham Gas Company are coming to Parliament; and the Corporation mean to oppose the Bill, with the overt intention of purchasing if they can come to terms with the Directors. With this object, they will also promote a Bill of their own. This seems a superfluous proceeding, and one that is not likely to be of advantage to the town if there is the remotest prospect of an agreement being arrived at between the Corporation and the Company. We notice that, at a recent meeting of the Cheltenham Town Council, it was stated that 25 years' purchase was a "probable basis" upon which the proprietors of the Gas Company might be bought out. It is not for us to say anything about the value of this undertaking; but it is pretty safe to indulge the reflection that, in these days of almost fancy quotations for investments of the "gilt-edged" order, it will take a strong inducement to persuade the contented holders of first-class gas stock to part with it. Parliament also will hardly encourage local authorities to undertake the responsibilities of gas supply unless there is good reason for it besides the hope of making a little money to aid the rates. The Leamington Corporation have also given notice of a Bill which is to contain provisions enabling them to acquire the undertaking of the Leamington Priors Gas Company "by compulsion or agreement."

The Engineers' Strike.

No visible change can be recorded this week in reference to the engineers' strike, except that the confederation of employers seems firmer than ever, and likely to extend to the East Coast of England; while the Amalgamated Society of Engineers have issued an appeal for support "in defence of Trade Unionism," which they declare has been assailed through them. If these manifestations of the spirit that is actuating the parties to the dispute are to be trusted, there is no other conclusion to be drawn from them than that this is going to be a decisive campaign. There is yet some hope, however, that as all the trouble sprang up suddenly over what from one point of view was a small question, so it may as suddenly subside, if both sides can be brought to accept a compromise in respect of this initial question—leaving the larger issue to be disposed of on some more convenient occasion. Possibly, if work is resumed before any further developments are opened up by either party, the threatened "Waterloo of Trade "Unionism" may be indefinitely postponed. Meanwhile, the disclosures respecting the financial weakness of the Amalgamated Society of Engineers made by the special correspondent of *The Times* in Glasgow have greatly incensed the Executive of the Society, who have put up the Secretary, Mr. Anderson, to reply to their "reckless and "irresponsible" critic. As we have had occasion to observe in connection with certain efforts of our own in this line, the official view of outside criticism is always that it is "irresponsible," and the official conclusion is apt to be that to say this is to answer the critic. Fortunately or unfortunately, according to the side from which an issue of this kind is regarded, officialism has no authority to dispose of hostile criticism otherwise than by refuting it; and in the case in point, the Secretary of the Engineers' Society has not even met the point raised by *The Times* correspondent, much less answered it. This point is that the Amalgamated Engineers' Society is a benefit or friendly society, with certain liabilities to its subscribing members, which are susceptible of actuarial determination; and that, owing to its affairs having been started upon a wrong basis, these liabilities cannot be met. This assertion is either well founded or it is mistaken. The only possible way of settling the question is to have a reliable valuation of the liabilities and resources of the Society made and published. But this obvious method of confounding their critic does not commend itself to the Union Executive. He, for his part, offers the information that "a full actuarial investigation of the published "accounts of the Society is being made up to date"—and he will probably take care that when completed the results of this inquiry shall be duly made public. It is clear, however, that the ordinary resources of the Society cannot be drawn upon to maintain the conflict with the Federated Employers in the shipbuilding industry, and consequently that the strikers will have to be supported by the proceeds of a special levy. One of the very worst features of the trouble, in the estimation of those witnesses of the state of things in Belfast and on the Clyde who would gladly see work restored, is the calmness and silent determination with which the conflict is being carried on. Doggedness is even worse to persuade than passion.

A Danger of Arc Lighting.

It was reported in the newspapers of the 18th inst. that on the previous day but one a terrible accident happened in the city of Cleveland, Ohio. An electric motor car, conveying between twenty and thirty passengers, plunged over a drawbridge in the central span of a viaduct, and fell into the river a hundred feet below. It was stated that, as the moving car approached the drawbridge, the conductor went forward to see if the line was clear; and being, it was supposed, "dazzled by the electric light," he gave the signal to the motor-man to go ahead, although the gates across the road were closed. The motor-man accordingly turned on the current; and the car dashed through the gate and fell into the water. Everybody who did not see what was happening and could not jump off was drowned—including the conductor, who was responsible for the mistaken order. We mention the dreadful occurrence here because it brings into prominence the great defect of the electric arc as a means for the lighting of public thoroughfares. When the lighting of the Tower Bridge was decided upon, and preference was given to gas for this service, the choice was determined chiefly in the interest of public safety. It has been a standing rule of the authorities responsible for the navigation of the River Thames that no arc light shall be permitted to shine upon the stream where it might dazzle the eyes of a look-out man or helmsman of any river craft. What has happened in Cleveland amply confirms the judgment of those who have framed and acted upon this rule. It would be deplorable if any similar disaster

in streets lighted by arc lamps were to bring the system into general disrepute; but this danger can only be prevented by keeping such lamps out of the direct line of vision of the drivers of vehicles. Arc lighting is not so generally admired by the British public that it can afford to run any additional risk of becoming discredited.

Mr. A. J. Balfour on the Metric System.

Among the most interesting of the recent deputations to Ministers was that representing British Chambers of Commerce, which waited upon Mr. A. J. Balfour, the First Lord of the Treasury, last Wednesday, to urge upon the Government the necessity of action being forthwith taken for carrying into effect the recommendation of the Select Committee in favour of the adoption of the metric system of weights and measures. The deputation was introduced by the indispensable Sir Albert K. Rollit; and Sir Henry Roscoe and other believers in the advantages of the substitution of metric for the Imperial and customary system of weights and measures had everything their own way, so far as the argument for uniformity was concerned. It is almost with feelings of pity that one contemplates the picture of Mr. Balfour—even supported silently by the President of the Board of Trade—exposed to the plausible pleadings of the metrical enthusiasts who would have their fellow-countrymen believe that British trade has a paralyzing incubus in the familiar triad of yard and gallon and foot. It is so easy to make out a case against these unrelated, "unscientific" units; so simple to ask that they should be abolished as obsolete; so attractive to forecast the results of the adoption of a universal system. We discussed the report of the Select Committee on July 9, and gave a general approval of its conclusions, although compelled to confess that there would be some difficulty in adjusting British gas prices to sales by cubic metre. We could not say, however, that there is any demand in the gas industry for such a change. The deputation to Mr. Balfour appear to have suffered from the same kind of weakness. They had no difficulty in proving, by logical process, the superiority of the metric over the customary and legal British systems of weights and measures; and they had reason for arguing that the substitution of the former for the latter would be a good thing, especially for foreign traders. But there was the stumbling-block of the difficulty of making the change.

It is all very well for educated gentlemen and men of science to declare that there would be no great inconvenience in making people give up quarts for litres, yards for metres, and pounds for kilos., because they have found the advantage of calculating in metric instead of in Imperial weights and measures. Unfortunately, the deputation did not furnish Mr. Balfour with a tittle of evidence to prove that a single Englishman who does not calculate in, but actually uses, the customary weights and measures has the slightest wish to give them up. This is the weakness of their case; and Mr. Balfour duly noticed it—confessing that, in his own case, he always experienced an "effort" in grasping the significance of metric dimensions met with in the course of reading. He also made a good point in reminding the deputation that even in countries where the metric system is the only legal one, the people still think and traffic in their old-fashioned, customary units of quantity and even of value. It is the truth of the matter that these customary units were not arbitrarily selected, but came into use because they possessed advantages of their own. It is not always possible nowadays to ascertain what these advantages were; and, as in the case of our own chaotic weights and measures, we can perceive clearly enough that the balance of advantage would be on the side of making a clean sweep of them all—if it were only worth while to have a fresh start. "There's the rub." One aspect of the metric system comes out very plainly from comparing it with the old systems which still retain their popularity. It is that, while the metric or any other decimal system of weights and measures commends itself to those instructed persons who have calculations to make in writing, nothing of the kind is so convenient to small dealers and people whose arithmetic is all done mentally as a system with aliquot subdivisions. We do not ever remember seeing this point dealt with in discussions upon the subject. For the rest, Mr. Balfour is willing to see what can be done to remove artificial restrictions upon the use of the metric system, and to help the rising generation to greater familiarity with decimal arithmetic.

WATER AND SANITARY AFFAIRS.

The project laid before the Royal Commission of 1892 by Mr. Walter Hunter and the late Mr. Alexander Fraser, for the construction of an extensive system of storage reservoirs in the neighbourhood of Staines, will receive partial embodiment in an important scheme to be brought before Parliament in the coming session. The plan of 1892 was intended to serve all the Metropolitan Water Companies with the exception of the Kent; and it was estimated to involve, in its entirety, a capital expenditure of £5,391,000. Adding to this certain capitalized charges, the complete sum amounted to £9,702,000. But it was not intended that all this should be undertaken at once. The work was to proceed by instalments, in accordance with the growth of the population—the scheme coming to its close in forty years. The plan now brought forward comprehends only three Companies, and is expected to cover a period of ten years, or perhaps something more than that, should the ratio of increase in the population decline, of which there are some indications. The present estimate for works only, independently of management, is, we believe, a million sterling. Future extensions can, of course, take place as required. In its original shape, the Staines scheme emanated from the Grand Junction Company, of which Mr. Hunter was a Director and Mr. Fraser the Engineer. The Bill of which notice has now been given proposes the creation of a Joint Committee, composed of representatives of the West Middlesex, Grand Junction, and New River Companies. It is sought that power shall be conferred upon these three Companies, and the Joint Committee, "or some or one of them," to make and maintain the specified works. The intake is to be placed a little to the west of Bell Weir—a point on the River Thames situated above the town of Staines. To the north of Staines, about midway to Stanwell, will be two large reservoirs; and about midway between these and the intake will be a pumping-station, contiguous to the River Colne. A conduit is to lead from the intake to the pumping-station, and pipe-lines from the latter to the reservoirs. A conduit from the reservoirs is to run down towards Sunbury, and, skirting Kempton Park on the north, enter a distributing reservoir in the vicinity of the works of the West Middlesex and Grand Junction Water Companies. This reservoir and the works of these two Companies will be connected; besides which a pipe-line will extend across the river into the works of the Chelsea Company, through whose mains a supply can proceed *en route* for the New River district. Power is to be obtained whereby the West Middlesex, Grand Junction, and Chelsea Companies will be enabled to convey water to the mains and pipes of the New River Company; and provision is made for the requisite agreements.

The fact that this project is a large slice taken out of the plan which came before Lord Balfour of Burleigh's Commission tells in its favour, seeing that the complete project was spoken of approvingly in the report of that Commission. The present scheme is virtually one of the instalments by which the larger one would have been carried out. There is nothing impracticable about it, nothing extravagant. It is true that the West Middlesex Company obtained power by their Act in 1894 to raise half a million of capital; and they are now constructing four large reservoirs, two of which it is expected will be ready for use in the course of next summer. When all four are in operation, they will have capacity for 350 million gallons. But reservoirs are useless without water, and are only useful in the degree to which it is found possible to fill them. The limit imposed by the law, as to the quantity of water to be taken from the Thames, is embarrassing. No doubt we shall hear the cry next session that the Thames is being depleted. Any such objection is met by the proposal in the coming Bill of the three Companies, that the flow of the Thames shall in no case be reduced below a certain quantity. We are told that the three Companies are willing to have the minimum flow over Bell Weir fixed at 250 million gallons for the 24 hours. In the scheme laid before the Royal Commissioners, 200 million gallons over Teddington Weir was proposed as the minimum flow. The condition then specified, that no water should be taken from the Thames during the first fifteen days of any flood, is still maintained.

There can be no question that the project to be brought before Parliament next year has been carefully matured, and will commend itself to the approval of the Legislature. Nothing can be said at present as to any advantage that will accrue to the shareholders by the raising of additional capital. Except one per cent. allowed for the cost of management, all the profit that would otherwise go in aid of dividends will be swept into the hands of the City Chamberlain, to form a sinking fund which that functionary will hold and apply as trustee "for the "purpose of purchasing and holding stock of the Company, "and of investing the dividends thereon with a view to "ultimately extinguishing the capital of the Company, or "for such other purposes as Parliament may from time to "time determine." At the outset, the clause corresponding to this was differently worded; and in the case of two of the London Companies, the Chamberlain, having purchased stock, forthwith cancelled the certificates—thereby "extinguishing" the capital after the fashion of the irate Irishman who burnt the notes of the Beresford Bank. This mode of proceeding, which tended to the benefit of the shareholders, is now prevented by a different wording of the clause; and the Chamberlain has to hold on. He has no power to vote at any meeting of the Company in which he holds stock; but should this redemption fund grow to any magnitude, it will have a rather curious bearing on the question of purchase. How lucky the chance which lodged the trusteeship in the City Chamberlain instead of the County Council!

The New River Company are going to introduce a Bill of their own, which proposes an extensive series of works, involving a very considerable outlay, for the purpose of improving and extending the supply. Some historical interest attaches to the provisions of the Bill, as it becomes necessary to ask that the Charter granted to the Company by James the First shall be amended and enlarged, and Acts of Parliament have to be dealt with as far back as the reign of Elizabeth. An important scheme of reservoirs at Walton-on-Thames is described in the notice which has been given by the Southwark and Vauxhall Water Company. A Bill altogether novel in its character is that by which it is proposed to establish what is called a Kent Water Board. This is to buy up the Kent Water Company's works, and so much of the undertaking of the Lambeth Company as lies within the County of Kent. Provision is to be made for the transfer of the part of the Kent Company's undertaking which lies within the County of London, "with or without the sources of supply, "works, wells, and pumping-stations," to the London County Council, "or any company or authority that has "been or may be established by Parliament for the supply "of water within the County of London." This Kent Water Board is to comprehend the urban districts of Beckenham, Bromley, Dartford, Erith, and Bexley, and the rural districts of Bromley, Dartford, and Sevenoaks. The promoters of the Bill are among the Local Authorities of Beckenham, Bromley, and Dartford. So far we have a movement in the outer area—one which is surely fated to encounter the opposition of the London County Council and two of the London Water Companies. The better plan, we consider, is to have a Trust, or Water Board, to comprehend all. In the case of the Staines reservoir scheme, we seem to have a foreshadowing of amalgamation, at least on the north side of the Thames. Engineering considerations, if none other, point in that direction. *London* says the introduction of the three Bills of which notice has been given "puts an entirely new aspect on the water "question." One thing, however, will repeat itself, and that is a parliamentary contest in which at least some of the Metropolitan Water Companies will be engaged. This may be accepted as inevitable; and as the gauntlet has now been thrown down by the Companies, the case—apart from the Bill by which the County Council seek to raise the height of supply in the East London district—differs in some measure from that incessant and gratuitous harassing by attacks from the County Council, of which Sir W. H. Wyatt made emphatic complaint at the half-yearly meeting of the West Middlesex Water Company last week—a Company who have nobly decided to continue their 10 per cent. rebate, and to meet the heavy expenditure incurred in sinking their mains to a lower depth by drawing on their reserve fund. But of course they will get little credit for giving away £20,000, which, in round figures, is what this work has cost them.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1103.)

ANOTHER wretched week on the Stock Exchange. At the close of its predecessor, some hope was indulged that the worst was all over, and that better times were in store. But things went all to pieces again. The very slight recovery which had been effected in prices was the signal for a rush to snap up the benefit; and all the advantage was soon extinguished. An immense volume of speculative accounts still await adjustment; weak people are being propped up on their legs by others who cannot afford to let them drop, and who are beginning to find themselves overweighted with the burden. Then political affairs were highly disquieting; and, as if more alarming factors were needed, rumours affecting the value of the gold-fields themselves were circulated. So, altogether, the week has been a most distressing one. Prices, of course, were knocked down liberally, and nothing escaped, whether gilt-edged or "wild cat." The Money Market had a better time of it; and rates hardened considerably at one time. The Gas Market showed some increase in activity; transactions being decidedly more numerous than in the week before. The tendency, on the whole, was not quite so good; and what changes there are in quotations are mostly downwards. They are, however, extremely few, and are for the most part mere fractions. Dealings in Gaslight "A" were numerous; and the inclination at first was favourable—the stock advancing a point on the opening day. Later on, however, a reaction set in; and the quotation closed half a point worse than the opening. The 7 per cent. maximum was freely dealt in at good middle figures; but none of the other secured issues was touched. South Metropolitans were moderately active at the old prices; but they showed no disposition to rise. In the Company's new Bill for conversion of their stock, the substitution of a 4 per cent. basis, instead of the 5 per cent. proposed in their old Bill, is a decided improvement. Commercials were quiet and unchanged, after their recent strong buying. Little was done in the Suburban and Provincial Companies; and changes were few. But Alliance advanced; while Bristol receded. Business in the Continentals was a fair average. Imperial showed further weakness; but the rest were steady. None of the others made any sign, except Bombay, which fell back a little. The Water Companies were not particularly active; and the general tendency was adverse. Grand Junction had a fall of 15 per cent., in view of the reduced dividend. The reduction in the Lambeth dividend had been anticipated. East London and Southwark were weaker. New River could not reach higher than 387, although at the Mart on Wednesday it fetched 400.

The daily operations were: Gas opened well on Monday, and was pretty lively. Gaslight "A" rose 1; and Alliance, ½. Transactions were fewer on Tuesday; and Imperial Continental receded 2. In Water, Grand Junction fell 1½. Business was up to the mark on Wednesday, and prices were steady. Bristol, however, dropped 1½; and Bombay, ¼. The turn on Thursday was unfavourable; and Gaslight "A" receded 1½. Grand Junction Water fell 3. Gas was active and unchanged on Friday; but Water was very weak. Grand Junction went down 3; East London, 2; and Southwark ordinary, 1. There was scarcely a bargain marked on Saturday; and quotations did not move.

ELECTRIC LIGHTING MEMORANDA.

The Conference upon the New Board of Trade Regulations—The Ventilation of Street Boxes—The Regulation of Interior Fittings—The Notification of Gas Leakages.

A CONFERENCE of an important character was held at the Westminster Town Hall last week—Sir Courtenay Boyle, the Permanent Secretary of the Board of Trade, in the chair—to consider the revised regulations made by the Board of Trade under the Electric Lighting Acts. The conference was largely attended by representatives of the various interests affected by the regulations; and the fairness and courtesy of the Board of Trade officials, in taking counsel with those who are identified with the interests in question, were duly acknowledged. The whole transaction supplies an admirable example of the readiness with which British administrators and the heads of important industries co-operate for the establishment of good mutual relations, and for furthering the best interest of the community which they serve in their different ways. In another column will be found a report of the proceedings in which the gas industry is closely interested. The first important subject discussed at the conference was electric pressure; and it was strongly urged, on behalf of the electric lighting industry, that the limit of pressure for low-pressure supplies should be raised from 300 to 600 volts. The Chairman intimated, at the close

of this discussion, that he was disposed to advise the Board of Trade to concede something in this direction. But he did not appear convinced that it would be advisable to go to the full length suggested by the electricians interested in central station lighting. The point was eventually reserved for reference to a small expert Committee. Upon the subject of the proposed requirement for a weekly testing for insulation of every complete circuit, which was objected to as unnecessary, the Board of Trade representatives stood firm. When the conference arrived at the consideration of the clause of the regulations which requires electric conduits to be so constructed as to keep out gas, there arose, as might be expected, a chorus of protestation from the electricians. It was urged that it would be unfair to electric lighting undertakers to lay upon them the burden of preventing the influx of gas into their conduits; it being sufficient for them to be responsible for preventing its accumulation in their subterraneous receptacles. This view was warmly supported by Mr. W. H. Preece, from his Post Office experience; and Mr. R. E. Crompton succeeded in persuading the Chairman that the difficulty might be overcome by making it incumbent upon electric lighting undertakers to use reasonable means to prevent the influx and accumulation of gas in their street-boxes, and to give notice to the gas companies whenever an accumulation of gas therein is discovered. Sir Courtenay Boyle accepted this proposal, on the understanding that there must be some further regulation in this respect.

On the second day of the conference, the subject of the ventilation of street-boxes and chambers was closely debated. Sir Courtenay Boyle declared that he had been forced to the conviction that the ventilation of transformer chambers is absolutely necessary; but he was not clear as to how far it is needful to ventilate street-boxes. In this mental attitude, he might have had the satisfaction of feeling that he was not singular; for this question of what is absolutely necessary to be done in the matter of ventilating street-boxes has exercised a good many people. Herein, however, the advantage of an opportunity for talking the matter over in conference was exhibited; for no difficulty was experienced in settling the point that, at any rate, transformer chambers, and street-boxes containing transformers, ought to be ventilated. This decision narrowed the problem down to one of street-boxes pure and simple. Then arose the question of when a street-box is a "box," and when a "chamber," as to which there has been much debate elsewhere. One speaker at the conference wanted the requirement as to ventilation to be applied to street-boxes exceeding in size one cubic yard, and another asked for an extension of the size of unventilated boxes to double this capacity. No agreement was arrived at upon the point; the Chairman observing that he would consider whether the Board of Trade could frame a regulation calculated to settle the question of size.

In regard to one set of regulations, the electric lighting interest will have an advantage denied to the gas industry. This is the facility which the regulations give for the prevention of bad interior fitting work. It appears from what was said at the conference by Professors Ayrton and Kennedy as well as by the Chairman, that, under the new regulations, householders will be made to feel that, unless the work put in is up to the standard established by the Board of Trade, there will be no prospect of the supply company turning on the current. Moreover, whenever the insulation resistance of interior fittings is found to fall below a certain amount, to be fixed by the Board of Trade, the supply of current will be cut off. This provision is, of course, primarily in the interest of public safety; but inasmuch as safe work also means good work in other respects, the electric lighting undertakers will have the satisfaction of knowing that their efforts to do their duty by the public will not be rendered nugatory by the remissness of housholders themselves. Gas companies have no such safeguard. What voltage is to an electric supply, that, broadly speaking, is illuminating power in a gas supply. But there are at present no statutory means of protecting the gas consumer from sacrificing the quality of his gas to his own careless or ignorant usage.

We have no reason to doubt that the new Board of Trade regulations, when issued, will prove reasonably satisfactory in operation. Our report of the conference shows that particular attention has been given to those points in which the interests and obligations of gas and electricity supply undertakers come into contact, not to say conflict, with one another. It must be regarded as reasonable that the owners of electric supply conduits and their accessory street-boxes and chambers have admitted it to be their duty to give notice of the presence of gas in these cavities; and it may be taken for granted that such notifications are not likely to go unregarded. Gas companies have no desire to fall foul of other statutory users of the public highways; but they cannot waive the point of their own priority in this occupation, when electricians complain of the occasional presence of escaped gas in the holes they make in the ground for their own purposes. Gas companies are bound by law to exercise due care to prevent escapes, and diligence in dealing with them when discovered; and they will be grateful to electricians or anybody else who may be able to warn them when escapes occur. Whatever the Lord Chief Justice of England may affect to think, gas companies are not omniscient, nor are their employees omnipresent throughout their district; and they are always open to receive information as to where leaks are to be found.

M. BLONDEL ON STREET LIGHTING.

A LENGTHY and elaborate memoir on "Street Lighting by Arc Lamps" has been communicated to *Le Génie Civil* by M. André Blondel; and a full translation of the text has been published in the *Electrician*. As a large proportion of this memoir deals with problems of street lighting in general, and is not limited to the application of electricity to this object, we propose to make an abstract of these portions of the paper, relying upon the accuracy of the rendering of the author's original text given by our English contemporary.

M. Blondel begins his learned disquisition by observing that our eye, growing accustomed to an ever-increasing brightness of lighting in the interior of dwellings, modifies little by little, and almost without our knowledge, its standard of luminous sensation; so that the quality of the public lighting which satisfies one generation appears meagre to the next. Hence, to satisfy this progressive demand, the most important streets of a city are first provided with a more intense system of lighting, which has the effect of making all the other thoroughfares look darker by contrast, so that the improved lighting has to be gradually extended throughout the town. So it happened at Toulouse, when the 45 street gas-burners of 10-candle power in the Rue Alsace-Lorraine were replaced by 16 arc lamps of 1200-candle power, it was found necessary to almost immediately extend arc lighting to the boulevards. It is the same in Paris, where the arc lighting of the grand boulevards has so increased the demand for better lighting that the advisability of brightening up the other streets is at present under consideration. M. Blondel believes that people will not be satisfied in this matter until artificial lighting becomes equal to that of average daylight. We are yet a long way from realizing this condition, seeing that the comparison of artificial and natural lighting presents something like the following practical order: Illumination of a plane area by the full moon, 0·6 to 1·0 *lux*; mean lighting of an ordinary roadway by a flat-flame gas-burner, 0·12 *lux*; the same by regenerative gas-burner, 1·29 *lux*; the same by electric arc, 2·0 to 3·5 *lux*; minimum lighting necessary for reading (Kohn), 10 *lux*; proper lighting for a picture gallery (Fleming), 10 to 30 *lux*; mean daylight for reading, 50 *lux*; direct sunlight, 70 to 100 *lux*. [For the meaning of the units of lighting measurement employed by M. Blondel, reference should be made to the JOURNAL abstract of a previous article by this author.*] M. Blondel declares himself to be of the opinion that the adoption of arc lamps for street lighting, and the popularity of incandescent gas-burners for private lighting, will oblige all large towns to make another step in advance. This, he thinks, cannot be attained except by largely extending the use of arc lamps, which, according to him, is the only solution offered by the present state of knowledge as to the means whereby good general street lighting can be realized. It will be gathered from this observation that M. Blondel is not in accord with the newest school of lighting experts, who hold that the advantages of arc lamps for street lighting have been greatly overrated.

In opening up his subject, M. Blondel declares that he means to treat it in an original manner. His guiding principles embrace two independent views of the problem of street lighting—the physical or photometrical, and the physiological. The latter he admits to have been too often neglected. To take the photometrical aspect first: It is necessary to begin by knowing the properties of the class of light source to be considered. The time is past when students of photometry were content to assume the candle power of lights as equal in all directions. This unjustifiable assumption usually perverted all their arguments. It is necessary to-day to discuss sources of light as they really are. As a rule, these sources have radiations which are symmetrical round the vertical axis; but the intensities of the radiations at different angles to this axis vary very considerably indeed. M. Blondel regards the "mean spherical luminous intensity" which is usually taken as representing the general effect of a light source as a mere useless artificiality, of no service in connection with the solution of problems of lighting, but rather the reverse. He discusses, with minute particularity, the effect of inclining the plane which receives the rays of a light source, and the influence of the height of lamps on the effect produced by them. The classical formula for determining the height of lamps for a known radius of lighting is $h = l\sqrt{2} = 0{\cdot}7\,l$, which M. Blondel rejects, at any rate for continuous-current arc lamps, and calculates that the proper elevation ranges from $0{\cdot}95\,l$ for the naked arc to $0{\cdot}5\,l$ for opal or holophane globes. Conversely, to secure a maximum range for a given light source, it is necessary to heighten the lamp by a corresponding amount in excess of the elevation determined by the classical formula. It further follows from the considerations advanced by M. Blondel that very different distributions of lighting effect can be derived from the same sources, by simply varying the height of the sources above the ground. Reference is made to the instructive work done by Maréchal, Wybauw, and Trotter in plotting the values of street lighting in Paris, Brussels, and London.

M. Blondel admits that it is a disputed point whether the value of the lighting actually received by a street surface, or

* See JOURNAL, Vol. LXIV., p. 1166.

the sum of the values of the light sources, should be taken as representing the lighting effect. Some engineers consider only the illuminating power of the lamps themselves; others give pre-eminence to the effect that is produced upon the ground. M. Blondel considers that to the latter should be added the complementary quantity of the vertical illumination, which is the degree of lighting received by the house fronts and everything else which stands up from the roadway. It is true that, as a rule, if the horizontal effect is satisfactory, the vertical one is sure to be even better; but this is not always the case when lighting a street is in question, different descriptions of light sources having different ratios of horizontal and vertical duty.

The manner in which the requirements of public lighting are stated is a very important consideration in connection with the letting of contracts for this service; and, in his remarks upon this head, M. Blondel makes certain admissions which cannot be esteemed otherwise than as a valuable testimonial to the usefulness of gas lighting. It appears that generally upon the Continent, and especially for the Belgian State Railway service, it was the practice to specify the area to be lighted, and the minimum lighting effect required. So long as this single condition was fulfilled, the contractor was left absolutely free to employ any principle of distribution he chose. Accordingly, as M. Blondel somewhat naively confesses, "In these conditions, it was very advantageous for the undertaker to exceed this minimum by the least possible amount, and, in consequence, to use small lights very close together, and to adopt gas in preference to electricity." Naturally, this state of things did not satisfy the electrical interest; and accordingly M. Weissenbruch lost no time in preparing an elaborate memoir demonstrating the "inconvenience" of such a condition, and asking for recognition of the value of the "superabundant light emitted by large lanterns at short distances." M. Weissenbruch desired to establish the new condition that the mean illumination of the lighted surface should be taken into account; and, to satisfy this requirement, M. Wybauw introduced his new conception of the "volume of illumination," which M. Blondel approves as having the merit of more fairly re-establishing the balance in favour of large lamps, since it takes account of the lighting effect which is produced at all distances. M. Wybauw wished, however, to strike out of the reckoning of useful lighting effect all increased brightness only found within a circle surrounding the lamp-post having a radius equal to the height of the lamp, on the score that this excess is useless. M. Blondel will not hear of any such device for discounting the gross value of high-power lights, while admitting that the characteristic of all light sources is the superabundant illumination produced by them in the immediate vicinity of the foot of the lamp-post. The effect of this is that of a spot of light with edges more or less clearly defined, outside which the lighting follows an extremely rapidly reducing law. All lighting engineers have been struck by this fact, and have been unanimous in criticizing it, and desiring a more equable distribution. If the lighting of the ground is the sole consideration, it appears obvious that the more uniform this can be made, the better. M. Blondel claims, however, that this is a mistaken view of the requirements of street lighting; and he denies that the perfectly uniform distribution of lighting in a thoroughfare, if it could be attained, would be popular. He declares that what the public desire is to have a street moderately well lighted as a whole, with some parts more brightly lit than the rest. The absence of the bright spots would not be compensated for by a slight rising of the general lighting value.

Let the general lighting be improved, by all means; but not at the expense of the bright spots under the lamps—this appears to be M. Blondel's position. At these points, he regards it as necessary to have lighting good enough to permit of easy reading; and the idea of uniformly distributing light must be given up, unless this relatively high illuminating effect can be secured everywhere. Even this might not be in every respect desirable. M. Blondel exposes the fallacy of attempting to improve the distribution of artificial light by elevating the lamps on towers; and he shows that the only situation in which lofty lamps are calculated to be effective is not in the open, but in narrow alleys surrounded by high houses. Experience proves that it is advisable to restrict public lamps to heights between 15 or 30 feet; the latter being permissible only for narrow thoroughfares without trees, in which diffusion by the frontages plays a really useful part. With regard to the location of street-lamps, various plans may be followed. The most economical and effective is that of placing the lamps in the axial line of the street; but, in order to secure a good effect, it is necessary to make the lighting at the point midway between two lamps the minimum, and let the lighting of the house fronts opposite the single lamp be slightly in excess of this standard. Where the streets are very narrow, however, the rule cannot be worked. M. Blondel lays it down in such cases that spacing the lamps 25 metres apart is the minimum below which arc lighting will not prove effective. Where the axial line cannot be followed in the disposition of lamp-posts, these may be placed in triangles, alternating on each side walk, or in opposed pairs. If central lights be combined with the latter arrangement, the effect is the best that can be obtained.

The quality of public street lighting, however, cannot be expressed simply in physical quantities. Over and above all that the photometer can indicate respecting it comes the verdict of the ultimate judge of such things—the human eye, which frequently refuses to submit to photometrical guidance. Since the opening of the pupil of the eye may vary in the ratio of 1 to 16, an object may appear to be anything from equality to sixteen times more brilliant for the same photometric illumination, according to the dilatation of the iris through which it is viewed. Hence the practical value of shading the eye from the direct vision of the source of light. Again, there is the well-known effect of contrast, which makes dark objects, in the immediate proximity of a luminous surface, look darker than they are. These are two physiological phenomena which modify, the first the virtual, and the second the relative, value of lighting, and are competent to render all physical measurements illusory. "This explains the singular fact," says M. Blondel, "that an absolute increase of light does not always give rise to a relative increase in public satisfaction. Let us replace, for instance, lighting by gas with lighting by arcs, and give 20 to 30 per cent. more total luminous flux. Very often the public will complain, and demand an increase in the number of lamps. This is a fact that it is necessary not to lose sight of when it is desired to substitute electricity for gas." M. Blondel further admits that, for really effective lighting, the eye should be permitted to take in as much of the light as possible, which means the employment of only such sources as have feeble luminous intensity. He confesses that the ordinary full-sized arc lamp, of 10-ampère consumption, is too much for many thoroughfares, and avows a preference for 8 and even 5 ampère lamps, which he must know are neither satisfactory nor economical in operation. It appears, therefore, that, on the whole, the effect of M. Blondel's essay is to discredit the system of lighting which it was intended to advocate, and to restore the reputation of lights of more manageable intensity, such as coal gas is fully competent to supply.

Society of Engineers.—At the ordinary meeting of this Society next Monday, Mr. W. T. Sugg will read a paper on "Ventilation and Warming." He will deal with the various requirements of buildings, show how to get rid of vitiated air, and indicate the best level at which to take in fresh air in London. The "gas aspirator" will be described; and church lighting and ventilation, as well as ventilation by diffusion, will be discussed.

The Bandsept System of Intensive Lighting.—The Société d'Incandescence Minérale has acquired a new intensive gas-burner, covered by the Bandsept patents, which the Company propose to work in England, France, Germany, Austria-Hungary, Italy, Portugal, and Holland. Surmounted by the Auer mantle, the Bandsept burner is claimed to give a light three times more powerful than any other, while at the same time effecting a saving of 25 per cent. on the gas consumed. The Société Belge du Bec Auer has entered into an agreement with the Société d'Incandescence Minérale to adopt the Bandsept system for public and private lighting whenever possible.

Personal.—Alderman Sir A. Forwood, M.P., has been elected Chairman of the new Lighting Committee of the Liverpool Corporation, in place of Alderman F. Smith.——Mr. Hayes has been appointed Secretary of the Greenhithe Gas Company.——In view of certain proposals for reorganization which are now before the London County Council, the Clerk (Mr. H. de la Hooke) will relinquish his position on March 31 next. The reason assigned for his retirement is a continual sense of physical inadequacy to discharge the duties of his office. Mr. De la Hooke has been Clerk of the Council since the retirement of Mr. J. E. Wakefield, on the dissolution of the Metropolitan Board of Works in 1888.——Mr. John Coates, M.Inst.C.E., was entertained at dinner last Wednesday by the Directors of the Colonial Gas Association, prior to his departure for Australia. Mr. Coates has erected gas-works in twenty-seven towns in Australia; and he also designed and carried out the hydraulic power works at Melbourne and Sydney.

Obituary.—We record with much regret the recent death of Mr. John Clapham, of Keighley. Deceased, associated with his brothers, Thomas and William, founded the well-known firm of ironfounders and gas apparatus makers which was subsequently converted into Clapham Brothers, Limited. He retired from the firm at the end of 1892. Mr. John Clapham was an octogenarian, and enjoyed remarkably good health until about three or four years ago, when heart disease made him a confirmed invalid. His removal breaks a long record of immunity from death in the family; and his many thoughtful acts, prompted by a kindly disposition, will be greatly missed by a large number of relatives and friends.——The death is announced as having taken place on the 20th inst., of Mr. W. Thorman, the Engineer of the Lea Bridge District Gas Company. Deceased was the eldest surviving son of the late Mr. E. H. Thorman, the Engineer of the West Ham Gas Company. After completing his articles, he entered the service of the Lea Bridge Gas Company. He was in his 51st year; and he leaves a widow and five children.——The Tynemouth Gas Company have lately lost their Chairman, Mr. John Moffatt, who had been a member of the Board for about twenty-three years.——Mr. Egerton Burnett, of Wellington, Somerset, a Director of the Wellington Gas Company, died on the 17th inst., in his 61st year. Deceased was proprietor of one of the largest mercantile concerns in the West of England.

NOTES.

A New Coal-Trimming Appliance.

A new and ingenious appliance for saving labour in coal trimming is being introduced by the Temperley Transporter Company; and a good example of the arrangement and its effect is to be seen at the Midland Coal Company's Woolwich Wharf. Originally the device was applied to the coaling of ships at sea, for which service it is held in good repute at home and abroad. As used for forming heaps of coal on land, the appliance consists essentially of a swinging beam, or spar, suspended by means of a hook from a gantry. Underneath the spar is attached a rail carrying a traveller, from which the skip is suspended. The traveller can be stopped at any one of a number of fixed points of the rail; and the skip can then be lifted or dropped. The load cannot move up or down while it is being traversed; nor can it be traversed while being hoisted or lowered. The whole movement of every kind is controlled by a single wire rope, which passes over a gin pulley at the end of the spar. At the Woolwich coal wharf, the spar is 85 feet long, and can be moved a distance of 40 feet along its gantry; so that the arrangement covers a large storage area. The beam and its working parts being self-contained, moreover, there is no reason why it should not be shifted from one gantry, or even pole, to another as required. In short, it appears to offer most of the advantages of a coke or coal stacking crane or gantry of a heavy permanent description. At the Woolwich Wharf, it has enabled the proprietors to dispense with the labour of eight of the trimmers formerly employed in stacking the coal as delivered by an ordinary crane.

Unsuitability of the Carbon Arc for a Standard of Light.

Referring to the efforts of Professor Violle and others (including himself) to base a standard of light upon the crater of the carbon arc light, Professor Silvanus P. Thompson has remarked that the suggestion of using (say) a square millimetre of incandescent carbon at arc temperature, as the standard of white light, is a very fascinating one. The result of all attempts to realize any such idea is, however, failure. Not only are there inherent difficulties, at the very high temperature that prevails, in getting the light through a small diaphragm fixed close to the arc, but Mr. Trotter has found in the light emitted from the carbon crater variations so extraordinary, that at present it seems unlikely that a true standard of invariable value can be attained in this way. These variations are due, in the first place, to the occurrence of impurities in the carbon, which lower either the temperature or the emissivity of the carbon. Most serious of all hindrances to the steady shining of the carbon arc, however, is what is now called, from its discoverer, the "Trotter phenomenon," because this is no question of the state of purity of the carbons. Mr. Trotter has found in the carbon arc an appearance of an object having a sickle, or comma shape, extending from some place near the centre of the crater to its edge, and continually revolving in a singularly capricious manner. Professor Thompson has described the phenomenon to a Society of Arts audience as a "chaff-cutter" action—sometimes going in one direction, sometimes in the reverse. Whatever it may be, however, the phenomenon is always exhibited when a carbon arc is in being; and this circumstance alone would be an effectual barrier to the use of the crater as a standard of light. Mr. R. E. Crompton has lately observed other apparently incurable vagaries of the arc light, which seem to indicate that, whatever other qualities it possesses, steadiness is never likely to be among its good points.

Are Free Hydrogen and Methane Present in the Upper Air?

Mr. Francis C. Phillips, of the Western University, Pennsylvania, has raised the curious question of whether free hydrogen and methane exist in the higher regions of the earth's atmosphere. The inquiry was suggested by the consideration that a good deal of these gases must have escaped into the atmosphere throughout all geological periods, and, if so, must still exist somewhere. Whatever may have been the process by which organic remains have in the course of time become converted into coal, petroleum, and natural gas, a considerable portion of the gases evolved in the early stages of decay of such remains must have poured out into the air before they became buried under sedimentary deposits. A very long time must have elapsed between the commencement of decay and the final burial of organic remains under marine deposits of sufficient thickness and compactness to cause the retention of the hydrocarbons until the sediment became consolidated into rock. In an earlier paper published in the *American Chemical Journal*, Mr. Phillips has shown that when organic remains are submerged under water, and protected from atmospheric influences, there is a great difference in the nature of the changes which occur first and last. The early stages of decay may be rapid, and much hydrogen may be produced. The later stages are more gradual; and methane may be the chief product of the decay. Swamp gases collected by the author indicate that shallow marshes may produce carbonic acid, nitrogen, and methane. In some deeper swamp waters, where masses of decomposing vegetable matter of great thickness occur, hydrogen is often found in small quantities mixed with carbonic acid, nitrogen, and methane. Carbonic acid and nitrogen are absorbed by vegetation; not so hydrogen or methane. Every bubble of these gases, once set free at the earth's surface, probably escapes unoxidized and unabsorbed to ascend into the upper strata of the atmosphere. Of all the forms which hydrogen and carbon can assume in Nature, free hydrogen and methane are among the most stable, unalterable, and insoluble. What, therefore, has become of all the gas of these two kinds that has gone into the atmosphere since the earliest geologic times? Mr. Phillips thinks it is somewhere high up in the air; and he has accordingly sought for it by means of the delicate reaction of palladium chloride at the summit of Mount Washington, which has an elevation of nearly 7000 feet. The experiment yielded only negative results. He still thinks that the gases are there; but he admits that serious difficulties would be encountered in any attempt to reach an altitude where the results of chemical tests could be regarded as conclusive.

Sands for Cement Mortar.

Some instructive tests of cement mortars mixed with different kinds of sand have been published in the *Journal of the Franklin Institute* by Mr. A. S. Cooper, U.S. Assistant Engineer. The occasion of making the tests in question was the construction of a concrete casemate for the United States Government, when there happened to be a choice between a fine beach sand, which was cheap, and a coarse river sand, which was very much dearer. Consideration of the strength of the proposed work would have decided the selection of the sharper sand; but it was found by experiment that the finer kind gave even better results. This was surprising to the experimenters, who accordingly looked further into the whole subject of cements and sands, with results set forth in Mr. Cooper's report. Without giving the data upon which Mr. Cooper has based his conclusions, it may be sufficient to state that he finds, other things being equal, that coarse is preferable to fine sand for cement mortar up to the size that passes a sieve with 12, and is stopped by one with 16, wires to the inch. Below the grade of sand that will pass 40 and be stopped by 60 wires to the inch, there is no practical difference in the value of any sands, so far as the size is concerned. The shape and condition of the surfaces of the grains of different sands has as much to do with their value for cement mortar as the size. The best sand is not necessarily the sharpest, if at the same time the sides of the grains are so smooth that the cement cannot properly adhere to them. Trap or granite sand, when sharp, appears to be the best kind of all for the purpose.

The Management of the Blackpool Electricity Department.—In the paragraph in the JOURNAL last week on the sale of gas and electricity at Blackpool, it should have been stated that the management of the Electricity Department of the Corporation, which was originally entrusted to Mr. W. Chew, is now in the hands of a separate staff and Committee. Mr. Chew is engaged entirely at the gas-works.

Manchester District Institution of Gas Engineers.—The 104th quarterly meeting of this Institution is to be held next Saturday at Leeds, under the presidency of Mr. Geo. Smedley, of Buxton. According to the programme of arrangements issued by the Hon. Secretary (Mr. S. S. Mellor, of Northwich), the members will meet at the Victoria Station, Manchester, and shortly after noon will leave for Leeds, where the meeting will take place at the Great Northern Hotel. The business will consist of the election of new members (five of whom have been proposed) and of the President for the ensuing year. Two papers are to be read—one by Mr. W. Newbigging, of Manchester, on "Tower Scrubbers and Horizontal or Washer Scrubbers;" the other by Mr. S. R. Ogden, of Blackburn, giving an account of the installation of carburetted water-gas plant at his works. After the business, the members will, as usual, take tea together.

New Pumping Machinery at the Hereford Water-Works.—New pumping machinery has lately been erected at the water-works of the Hereford Corporation; and on the occasion of putting it in operation for the first time, the City Surveyor (Mr. J. Parker, Assoc.M.Inst.C.E.) read a report which contained the following particulars: The engine (supplied by Messrs. Worth and Mackenzie) is of the triple-expansion condensing type, direct-acting with overhead marine pattern cylinders 13½, 21½, and 36 inches diameter and 30-inch stroke, driving three single-acting ram pumps 16 inches diameter lifting 100,000 gallons per hour. The engine-house (erected by Messrs. Bowers and Co.) is arranged to correspond with the existing buildings; and the floor is depressed 1 ft. 3 in. below the old engine-house floor, in order to reduce the suction as far as possible. All special pipes and valves are so arranged as to provide for future extensions, if or when required. Two valves with standards and hand-wheels with two 6-in. self-acting reflux valves, in one operation regulate the supply to the tower or the storage reservoir without stopping the engine. The arrangement is an ingenious one, and is much better than that of disconnecting the high-lift pumps, which would have rendered a stoppage of the engines necessary each time the tank on the tower was filled. The duty discharged by the old high-pressure pump is performed in an economical manner by a pair of high-lift pumps attached to the intermediate engine, capable of delivering 15,000 gallons per hour, either to the tower or the reservoir at pleasure.

COMMUNICATED ARTICLE.

KEEPING UP THE GAS SUPPLY WITHOUT A GASHOLDER.

By G. Ernest Stevenson.

A question having been asked in the columns of the JOURNAL as to the feasibility or otherwise of keeping up the gas supply to a town without the use of a holder, it has been thought that a reference *in extenso* to the instance in the author's experience in which this was satisfactorily accomplished, would be of interest to the readers.

The instance occurred in the year 1890, in connection with the establishment of a gas-works in the Argentine town of Paraná. The author had acted as Engineer in the construction of the gas-works, which had been opened without any hitch in February of that year. The gasholder was a two-lift one, 60 feet in diameter, in a cast-iron tank. The inlet and outlet pipes were connected in the manner usual with such tanks, by duckfoot bends underneath the tank; the bends being bolted through to stand-pipes inside the tank. About six months after the opening of the works, in July, the joint of the bottom flange of the outlet stand-pipe gave way, and the water in the tank flooded the mains. A temporary connection was immediately made between the inlet-pipe and the outlet-pipe in the ground outside the tank, and the outlet-valve closed; and the supply was continued through the inlet-pipe. The Directors of the Company, however, desired to have the outlet-pipe repaired, and consulted the author regarding the steps to be taken to effect this. As the joint was inside the tank, it was impossible to repair it without emptying the tank. To stop the supply of gas for this purpose would have seriously prejudiced the Company with its consumers; and it was therefore determined to attempt to continue it without the holder.

At the time the accident occurred, the consumption of gas was about 60,000 cubic feet a day; there being two settings of six retorts each fully at work. Before commencing the experiment, it was necessary to put additional retorts into action, sufficient to produce gas at a rate equivalent to the maximum draught on the mains in the heaviest hour of consumption. The amount of maximum draught was arrived at by observing the make of gas and the delivery from the holder during each quarter of an hour of the evening; and it was estimated that one additional setting of retorts would just suffice for the purpose. When this setting had been heated up and brought into full working order, preparations were made for the experiment. First of all, the day before commencing it, all the purifiers were emptied and recharged with clean oxide; and during that night the charging of the retorts was suspended in order to empty the holder. During the next day only two retorts were charged alternately; and it was found that the gas they produced was just sufficient to balance the day consumption at 5-10ths pressure, the gasholder remaining stationary although still afloat. A pressure-gauge was fixed in the retort-house communicating with the leading main, so that the pressure in the mains could be observed. The gasholder was then shut off, the bye-pass valve of the governor opened, and the governor itself thrown out of action; and supply direct from the retorts commenced.

As the time of sunset approached, the author stationed himself at the gauge in the retort-house; and, the stokers being ready assembled, with coal laid down for charging all the retorts, as soon as the pressure began to fall, the order was given to charge one retort after another—the rise and subsequent fall of pressure being noted between each charge, until several retorts were under weigh. It then became necessary to pause for a time; for the production of gas from the retorts already charged continued to develop, and the pressure to rise. It was not long, however, before more retorts were required; and the charging was continued until all were at work. The danger to be feared was either that the pressure would increase too rapidly and blow the water out of the consumers' meters, or that it would fall too low and a deficient supply occur. By care in charging, it was found possible to prevent the former occurrence; and when all the retorts were charged, it was found that a pressure of about 20-10ths was maintained throughout the remainder of the evening.

As the consumption fell off before midnight, a reduced production was necessary; but as the retorts had been charged at different times, extending over a period of two hours between 6 and 8 o'clock in the evening, the diminution in the production as the charges became exhausted was so nearly equivalent to the reduction in the consumption of gas that no difficulty was experienced. About midnight it was found necessary to recharge some of the retorts, to supply the gas consumed in the public lamps; and these second charges sufficed till daylight arrived—a pressure of about 10-10ths being kept up after midnight. The next morning the alternate charging of two retorts was reverted to, which again sufficed to keep up the day pressure of 5-10ths.

The first night's attempt having been successful, there was nothing to fear subsequently, except in the case of a sudden change of weather. Fortunately, however, the weather remained absolutely uniform the whole of the period during which the experiment lasted—not a cloud being once seen in the sky. The emptying and refilling of the gasholder tank, together with the repair of the joint, occupied eight days; and at the end of this time the holder was again brought into action without the consumers being aware that anything unusual had taken place.

There were some circumstances that favoured the success of the experiment, which might not be found in conjunction in this country. In the first place, the steadiness of the weather prevented fluctuations in the consumption day by day, which were also absent largely as a consequence of the residential character of the town. Secondly, the mains were of ample capacity for the draught put upon them. The leading main proceeded in a straight line for nearly a mile before entering the town; and there was a gentle rise the whole way; so that even if the pressure in the works had fallen to zero for a moment or two, there would still have existed pressure in the town. The long main of ample diameter formed a compensator for variations in pressure. Also a large proportion of the consumption was due to the public lamps, which, once lighted, continued to consume the same fixed quantity per hour throughout the night.

There is, however, one thing that would assist such an experiment in any town; that is the compensatory power inherent in the consumers' burners. These not being fitted with regulators, would be the cause of an increased or diminished consumption proportionate to the pressure, and would facilitate the establishment of an equilibrium if certain limits of variation were not exceeded.

One difficulty would arise if the experiment were very prolonged; and that would be connected with a change of purifiers. It would not be possible to preserve unbroken the day pressure when the purifiers were changed, unless the air in the newly-filled purifier were allowed to go forward into the mains, which would probably produce a disastrous effect on the illuminating power of the gas when the time for lighting up came, for the air would remain together in a mass in the mains, and move forward in a wave when the draught set in. In a small township, however, if notice were given to the consumers, no serious objection would exist to the suspension of the day supply for a short time, during which the air could be blown out at the vent-plugs of the purifiers. The time occupied in doing this would be too short to cause infiltration of air into the mains through loss of pressure.

It should be remarked that in the experiment recorded, care was taken in the first instance to have the retorts very hot, so that rapid evolution of gas commenced immediately they were charged. The standing off in the day-time itself brought about the condition of high temperature so necessary in order that the experiment should each evening be successful.

Grand Junction Water Company.—In consequence of the very heavy expenses entailed by the frost of February last, the dividend of this Company for the past half year will be 3 per cent. on all classes of shares; making 6½ per cent. for the year ended Sept. 30.

The Polarization of the Light of Incandescent Bodies.—The polarization of the light emitted by incandescent bodies has not yet, says *Nature*, been fully investigated. Arago, indeed, made some experiments on incandescent iron, platinum, and glass; but these were only qualitative, and did not extend to liquids. Mr. R. A. Millikan publishes, in the *Physical Review*, an account of some careful tests of light emitted by glowing solids and liquids, with a view to discover the laws of its polarization. This phenomenon is exhibited strongly by incandescent platinum, silver, and gold, and by molten iron and bronze. A somewhat feebler polarization is shown by copper, brass, lead, zinc, and solid iron. The most significant result is that polarization is minimum with rays emitted normally to the surface, and maximum at a grazing emission. This indicates that the vibrations take place in a plane at right angles to the emitting surface. To show the phenomenon at its best, a smooth surface is essential. Glass and porcelain also emit polarized light, but to a lesser amount. Fluorescent bodies do the same; so that evidently a high temperature is not necessary.

The Development of Artificial Light.—In the course of his Cantor Lectures at the Society of Arts on the subject of the "Arc Light," which have lately been printed in the Society's *Journal*, Professor Silvanus Thompson, F.R.S., dealt with the question of luminous and non-luminous energy. He remarked that one of the things we have to look forward to in the development of artificial light is the production of lamps which shall be of a higher efficiency than the arc lamp. They must, for an equal amount of energy supplied to them, emit a far greater percentage of waves of a length that will affect the eye as luminous waves, and a far less percentage of those longer waves which do not help the illumination, but which only warm. Such a transformation had, he pointed out, been wrought for gas lighting in recent years by the introduction of Dr. Auer's incandescent mantle. He discovered a material of which the emissivity, at the temperature of the gas-flame, is higher than that of the carbonaceous matters in the ordinary flame of coal gas. It emits a greater percentage of waves of the sorts that affect the eye, and a lesser percentage of the non-luminous waves. The vacuum tube lamps, and their modern varieties—such as Tesla's lamps and Ebert's luminescence lamp—are attempts to procure a better specific luminescence from a given amount of energy.

TECHNICAL RECORD.

AMERICAN GASLIGHT ASSOCIATION.

Annual Meeting in Philadelphia.

(*Continued from p.* 1034.)

Mr. W. W. Goodwin, of Philadelphia, delivered a lecture on "Acetylene." He exhibited a drawing of the apparatus used by Mr. Willson for the manufacture of this substance, which includes a twin Leffel turbine, 30 inches in diameter, making 206 revolutions per minute at 28 feet head, and developing 300-horse power at ¾-inch gate opening. This is belted direct to two Thomson-Houston alternating current dynamos run in parallel, and separately excited by two standard exciters from a 120 kilowatt machine. Each machine generates 1155 volts at full load, at a speed of 1070 per minute, with 125 alternations per second. The primary wires are connected in multiple to sixteen Thomson-Houston transformers of 15,000 watts capacity; and the primary windings have a range of from 52 to 104 volts, and have 60 cycles per second. The secondary windings are connected in parallel to the two furnaces by means of eight wire cables, respectively attached to the anode and cathode of each furnace. Each anode is made of six carbons, each 4 inches square and 3 feet long, held in a group by a holder. After running seven consecutive periods of four hours each, these are reduced in length ½ inch. The cathode is an iron plate 2 inches thick, on which is superimposed a layer of carbon 12 inches thick. The carbon pencil is raised or lowered by a screw and hand-wheel, and is adjusted by the attendant as the current varies. The average shown during three days' working was 64 volts and 1980 ampères; the horse power consumed was about 160; and the quantities of mixture (87½ lbs. of lime to 56⅓ lbs. of carbon) operated upon were respectively 1142, 1246, and 982 lbs. The proportion named is calculated to yield 100 lbs. of calcium carbide, and 43¾ lbs. of carbonic oxide. One hundred pounds of the carbide yields 40·62 lbs. of acetylene and 115·62 lbs. of slaked lime; or 5·9 cubic feet of acetylene per pound of carbide. Several experiments with the carbide and acetylene were then exhibited. The carbide was submitted to the heat of a blow-pipe flame, to show its infusibility and uninflammability. The properties of liquid acetylene were also illustrated, as well as the use of acetylene for enriching ordinary town gas. The lecturer also showed the explosive properties of acetylene when mixed with air, which he considered fatal to its dilution with air for practical use. As to the commercial cost of acetylene, £4 per ton was a liberal estimate.

Mr. F. Egner, of Norfolk (Va.), followed with a paper bearing the title of "Notes on the Storage of Oil at Gas-Works." Wooden vessels were the first used for this purpose; and it was soon found that they would not remain sound, so they were surrounded with a water-jacket. The first improvement seems to have been the adoption of the principle of the gasholder, by using a tank open at the bottom, placed in a reservoir of water. Oil admitted to the interior kept on the surface and displaced the water, until it was full of oil. This was the precursor of an oil-tank for gas-works, designed by the late Mr. T. H. Forstall. A little later, a further improvement was made, consisting of keeping the tank always under pressure and full of liquid, so as to avoid accumulation of gases or vapours, and the consequent danger of explosion. Next in order was the use of a coil of steam-pipes at the bottom of the tank, for the prevention of the accumulation of solid deposits. The water-covered top, the entirely submerged tank, and the safety-tank placed at a lower level so that the contents could be run off in case of fire, were also introduced a quarter of a century ago; and various devices were suggested for getting rid of the vapours with safety, the prevention of firing-back, &c. Attention was then directed to a drawing of the oil-tank patented by Mr. Forstall in 1871, which was on the gasholder principle, with a slight rise and fall. Any tight gasholder and tank could readily be adopted for this purpose. The late Mr. Flannery, when pressed for room, used a part of the water space in his relief holder as an oil-store; and this was a convenient and absolutely safe arrangement. For large works, the author preferred Mr. Forstall's plan; and for small ones, a vertical cylinder with glass gauges connected at the top with the inlet of the gasholder, by which means it was kept under pressure, and quite safe. He had adopted the plan of connecting the oil-tanks with a gasholder more than 20 years ago; and having used it with perfect success, he was surprised when it was called into question a few months ago. He described the arrangement of tanks he now employed, as well as some special experiments showing that there was no loss of oil by evaporation. The plan of keeping the oil under a slight pressure greatly diminished the production of vapours. He always provided a light resistance vacuum valve, and also a light pressure safety-valve.

In the course of the discussion, Mr. Alex. C. Humphreys remarked that tanks containing naphtha required to be protected from the direct rays of the sun. Mr. Newell said that at New Brunswick the tanks were all underground; and Mr. Thompson objected to underground tanks, as during a heavy storm he had known them to be lifted out of the ground by the water. Mr. Gartley had his tanks connected with the holder by a 6-inch main, but always found traces of naphtha vapour in this pipe. Mr. Pinckney said that at Utica the temperature was sometimes 40° below zero; and then the oil would not run. He had adopted the plan of running a steam-pipe parallel with the suction, and lapping both together with non-conducting material.

Mr. E. G. Pratt, of Des Moines (Ia.), read a paper on "Bench-Firing with Soft Coal." He said that the only reasons which would justify this plan were cheap coal and a large demand for coke at a good price; and it was these circumstances that led him to endeavour to design a setting that would show the best results obtainable with coal as fuel. He tried various plans as used successfully in other places, but with very indifferent results—probably on account of the poor quality of coal available both for fuel and for gas making, and also because coal furnaces required more care and attention than those for coke. This was particularly the case where the quality was apt to vary. With coke-fires, the ports and dampers could be adjusted once and for all; but with coal, a great deal more was needed. There was more frequent firing and clinkering, coal to be wheeled in, and more clinker to be removed, all of which meant increased labour to the stoker. During the past six years, he had tried three different settings. The first was three beds of sixes, built in 1889, on the half-depth regenerator principle. The second, three similar beds, with the exception of an additional foot depth in the furnace, and the arrangement of the flues and upright pipes in the regenerator. The principle was right; but the construction was not strong enough—especially in the regenerator—for the extra strain. Although fairly good results were shown at first, trouble soon arose from the stopping up of flues and pipes, and breakage of the latter, notwithstanding the fact that coke was used once a week to burn out accumulations of soot, &c. In 1893, six new beds were constructed in the old arches, having greater strength and larger flues, and abandoning the upright or so-called organ-pipes in the regenerator. The furnaces were also still further deepened, so as to get a larger combustion chamber. These were started in October, 1893; and the results of four months' working were 3,090,500 lbs. of coal carbonized, 14¼ million cubic feet of gas made, four-hour charges averaging 305 lbs. per charge, a yield of nearly 8000 cubic feet per retort, a make of over 2,000,000 lbs. of coke, of which 95 per cent. remained for sale (the remainder being used for fuel on Sundays), and a consumption of 73 lbs. of coal for fuel per 1000 cubic feet of gas made. The figures for the corresponding period of the following year, when the same furnaces were used with coke as fuel, were: 2,868,900 lbs. of coal carbonized, to make 14 million cubic feet of gas; the average weight per charge being 362 lbs., and the make over 9700 cubic feet per retort. About 30 per cent. of the coke, or 33 lbs. per 1000 cubic feet of gas made, was used as fuel. After allowing for the extra cost of labour, &c., the conclusion was arrived at that the use of coal instead of coke for fuel resulted in an actual saving of about £500 for the four months. Not considering the results obtained with coal to be altogether satisfactory, the author had lately arranged a month's trial under more rigid personal supervision. He then found he could get results nearly as good as those obtained with coke fuel, with a consumption of only 59 lbs. of slack coal per 1000 cubic feet of gas made. Another month's trial, with lump coal as fuel, gave rather better results, with a consumption of only 41 lbs. of coal per 1000 cubic feet.

Mr. Thompson opened the discussion by pointing out that the coal for fuel was liable for various reasons to much greater variation in quality than coke, and that more intelligent attention was therefore required on the part of the men. At St. Louis, he had used coal as fuel for five years, in furnaces resembling those described, with material economy and satisfactory results. Like the author, he had found the need for more space in the flue-ways. If it was necessary for any reason to fall back on the coke, there was a difficulty in keeping up the heats. He found an increased supply of air, with a little steam at the outlet to increase the draught, better than coke firing for clearing the flues. Lately, having a cheap fuel coal and a good demand for coke, he had found it better to go back to old-style furnaces, as recuperators did not pay with cheap fuel. He quoted figures from his last ten months' working, showing an average weight of 448 lbs. per four-hour charge, and a consumption of 570 lbs. of coal as fuel per ton of coal carbonized. It would be noticed that in the summer he used about one-fourth of coke breeze as fuel. An essential novelty in these particular furnaces was the provision of five ports for the admission of air above the furnace, each controlled by a cover or damper. When the furnace was charged, all these ports were opened; and they were gradually closed as the fuel became coked. The outlet-damper required adjusting in a similar manner. With the use of breeze mixed with the coal, this regulation was not of so much importance. He expected to see coal firing generally adopted wherever the prices of fuel were anything like those in his district. Mr. Mitchell said that, after many experiments, he had devised a furnace on the half-depth regenerator principle that gave good results with coal. He attached a great deal of importance to regeneration and a secondary air supply, which was necessary to secure proper combustion of the gases. He had used organ-pipes for the last twelve years, and considered them the best and simplest means of heating the air. They were not liable to break; but if they

did, they were cheap and easily renewed. He claimed to be the first to use coal as fuel under the retorts, and said he had made a great success of it. The extra work was not so great as appeared at first sight. Very little more weight of fuel was used, and the bulk was less; while the clinkering was not more laborious than with coke. The fires, however, did require more attention. Mr. Russell thought perfect recuperation was of great importance in coal-burning. In the West, it was always advisable to be able to use coal or coke as desired, according to the markets. Both Mr. Harper and Mr. Ramsdell said they had used coal firing with good results, and with no difficulty.

(To be continued.)

THE COMMERCIAL VALUE OF PHOTOMETRY.

(Concluded from p. 1035.)

Photometrical Works.

Now let us consider briefly the photometer and its manipulation. Photometry has been developed as the result of the conscientious independent labours through many years of many scientists and engineers. Photometers have been devised upon different principles in optics, including diaphragmation, dispersion and the phenomena of absorption, polarization, compensation, &c. Chemical photometry has also received attention. But the photometers which we are most interested in are those based upon the direct comparison of two illuminated surfaces—as the Rumford, the Bouguer, the Foucault, the Bunsen, and the Arnoux. The first four depend upon the law of distances; and the last, upon the cosine law. The Bunsen is chiefly employed in America, Great Britain, and Germany; and the Foucault in France. The Rumford is generally regarded as obsolete, though such a high authority as Captain Abney prefers it above all others. On the other hand, Mr. Dibdin pronounces against it.

Inferential photometry has been the subject of much investigation; and the jet photometer and the illuminating-power meter have been largely used. Many schemes have been suggested for calculating the candle power of a gas from its contained illuminants, or from the composition of the products of combustion. Investigations as to the cause of luminosity in gas-flames, and especially the recent investigations of Professor Lewes, William Young, Irwin, and others, indicate that inferential methods cannot safely be employed for the general comparison of the illuminating power of gases; and for long we have known that the character of the diluent gases modified the readings of inferential photometers. But for the comparing of gases made from the same class of materials and by the same apparatus and methods, they can be made to serve a useful purpose.

In the so-called Bunsen photometer, we find an instrument which is practically accurate, and as simple as any such laboratory instrument can well be. It gets its name from the grease-spot disc. Bunsen's photometer was quite different from the one now employed. Mr. Alfred King, of Liverpool, took the Bunsen disc, and built round it the photometer much as we use it to-day. He employed the open photometer in a dark room, the bar 100 inches, the two lights fixed, and the disc set up without sight-box and without mirrors, but reversible with regard to the lights. This photometer has since then been modified in many ways. A wide departure was made in the Evans. As originally made, it was not adapted for general testing. In some of its present forms, it is no doubt a reliable instrument, and especially so when the lights are fixed and the ventilation better provided for, and the sight-box properly screened. Dr. Letheby introduced the sight-box as now generally used. This is an improvement, inasmuch as the mirrors enable us to see the two sides of the disc simultaneously; but it fails to provide, as did King's arrangement, for the reversal of the disc with regard to the lights, to compensate for differences in its two sides.

The elaborate and able report of the Dutch Photometry Committee* makes a strong point of the necessity for this reversal. It goes farther, and says the readings should be made one-half from one side of the table and the other half from the other side—this to compensate for differences in the eyes of the observer. The report condemns the English practice of correcting for candle and gas consumption by the proportional rule; and also the employment of two candles instead of one, especially if the distance between the disc and the candles is allowed to vary.

Mr. Dibdin urges the importance of the reversal of the disc; and he has improved the sight-box by pivoting at the back the frame containing the disc and mirrors, so that it can be revolved around a horizontal axis. His design is to thus compensate also for any differences in the mirrors. This is possibly a refinement; but it behoves us to adopt all such refinements, if they do not lead to complication of apparatus and methods.

The selection of a disc is all-important. No matter what form is used, it should be tested by the reversal method; and unless the readings are then alike, it should be rejected. A disc should be rejected wherein the spot entirely disappears.

After a good disc has been selected, we must remember it is liable to change, and especially under constant exposure to light and a dirty atmosphere. A disc that becomes soiled or marred should be abandoned.

In my opinion, the Leeson star-disc is a decided improvement over the regular Bunsen disc, and especially in connection with difference in the colour of the two opposed lights. Mr. Dibdin strongly endorses the star disc; but he holds that, as first made, it was not satisfactory on account of "buckling." He improved it by fastening the three pieces of paper together with thin starch water, under pressure. Captain Abney and Professor Lewes endorse the Dibdin-Leeson disc for its reliability, even when this difference in colour exists. Captain Abney suggests, as an additional safeguard against error in disc reading, the oscillation of the disc between points too dark and too bright, gradually reducing the length of swing.

Referring again to the other points noted as made by the Dutch Committee, I believe the majority of American and English experts agree that, under certain restrictions, the use of two candles tends to decrease rather than increase the total error. The obliquity of rays does not sensibly affect the reading if the disc is not closer than 12 inches; and a reference to the following table shows that, up to 30-candle power gas, this distance is more than 12 inches, even with the 60-inch bar.

But these and other sources of error connected with the use of the much-abused candle standard can apparently now be eliminated by the adoption of Dibdin's 10-candle pentane Argand air-gas standard. This standard (as a development from the Harcourt 1-candle pentane standard) has been under careful examination by English scientists and practical photometrists for some years; and the Photometric Standard Committee, in their recent report to the Board of Trade, recommends its adoption for the testing of London gas.* The strength of the Committee and the record of their work will, no doubt, secure the adoption of their recommendations. It seems to be demonstrated that this standard gives uniform results, even with considerable variations in temperature, pressure, height of flames, and the composition of the pentane mixture. Mr. Dibdin states that the height of the flame may vary 1½ inches without sensibly affecting the amount of light reaching the disc therefrom. It is true that there are those in England who do not endorse the Committee's recommendation.

Mr. Williams has recently objected to this standard on the ground that it refers back to the candle as its unit; and, therefore, its use is simply a roundabout way of using candles. The reasoning does not appear to be sound; for if the pentane lamp gives constantly uniform results without too great complexity, we make a decided gain. Further, the unit of the proposed standard is the mean obtained from a great number of readings by most competent photometrists, and therefore is, in that regard, far more reliable than any isolated observation.

Another decided advantage possessed by the pentane standard is that it is of a relatively high candle power. Referring to the following table, we see that, with this standard, the intensity of illumination of the disc more nearly corresponds to moderate degrees of diffused daylight, and the eye is capable of making, under these circumstances, finer distinctions than if the intensity of illumination was either excessively low or high.

With regard to the comparison between bars of different lengths, the statement is sometimes made that the change from King's 100-inch bar to Letheby's 60-inch bar was an improvement. I confess I have not in the past agreed with this statement.

Comparison between 60-Inch and 100-Inch Bars.

D. Distance of disc from light standard, in inches.
I. Intensity of illumination of disc in terms of 1 candle at 1 foot.

Candle Power of Gas.	60-Inch Bar. Standard. One Candle. D	I	Two Candles. D	I	Ten Candles. D	I
16	12·00	1·00	15·66	1·17	26·49	2·05
20	10·96	1·20	14·42	1·38	24·84	2·33
25	10·00	1·44	13·23	1·64	23·24	2·66
30	9·26	1·67	12·32	1·90	21·96	2·98
	100 Inch Bar.					
16	20·00	0·36	26·13	0·42	44·17	0·73
20	18·27	0·43	24·04	0·49	41·41	0·84
25	16·67	0·52	22·04	0·58	38·74	0·96
30	15·44	0·61	20·52	0·68	36·60	1·08

An examination of the table confirms the claim to improvement. On the 100-inch bar, with the 1-candle standard, the intensity is only from 0·36 to 0·61 foot-candle; and even with the 10-candle standard, the intensity only reaches 1·08 foot-candles. The 60-inch bar is, therefore, to be preferred for the ordinary gas testing; for the testing of high-power light-sources, a larger bar should be employed. If we have our dark-room of

* This report was noticed in the JOURNAL, Vol. LXIV., pp. 1161, 1209.

* The Committee's report will be found in the JOURNAL, Vol. LXV., p. 1010; and a description of the Dibdin standard on p. 1021 in the same volume.

sufficient length, and we are not constantly making such tests, they can be conveniently enough provided for by having a full-length portable table, the calculations to be made from tape measurements. But in this connection it is well to bear in mind that, with new forms of light sources, and especially with high-candle power lamps, the candle power should be taken spherically; and for this a radial photometer is required.

For the comparison of the illuminating power of gases, a horizontal test is sufficient, because the character of the gas does not change the result, except in a minor degree by reason of the flames of higher candle-power gases having a greater absorptive power for their own light than lower candle-power gases, as already referred to. With the flat-flame burner, this can be provided for by making the test with the burner at such an angle as will give the mean angular candle power.

For spherical photometry, Mr. Dibdin has improved the Hartley "Universal" photometer by arranging the disc so that it can be readily adjusted to receive the rays from the standard and the light-source under examination at the same angle of incidence. This at once eliminates the necessity for correction on account of the cosine law, and also the departure from that law by reason of variation of absorption and reflection with the angle.

Upon the important questions of corrections for variations in the gas and candle consumptions, there exists considerable difference of opinion. The English method, which is followed in America, provides for correction by the rules of proportion. Many English experts have long held that a method more nearly like the French—viz., the measuring of the quantity of gas required to give a standard candle power—should be employed. The report of the Photometric Standard Committee recommends that the present rule "be rescinded, so as to allow the Gas Referees to sanction a mode of testing in which the gas shall be burned from the standard 'London' Argand burner at whatever rate is found requisite, in order that it may give a light equal to that of the prescribed number of candles in which the illuminating value of the gas shall be calculated as being inversely as the rate at which such gas had to be burned during the testing, so as to give this amount of light."

This may, on the average, be a fairer rule than the present one. It more especially applies to the testing under English conditions, when there is in each case a prescribed candle power to be maintained. But any such rule must be arbitrary; and its discussion is not necessarily involved in the question of measurement of light. If we could, in the case of each gas, fix such conditions as would give the nearest possible measure of the absolute illuminating value of the gas, we should have made a great step, and be in a position to avoid many of the difficulties involved in the question of difference between candle power and illuminating effect.

But I cannot see that we can ever hope to make a direct comparison between the absolute illuminating value of gases; for how can we ever say that any given burner accords to any two gases of different composition the same percentage of illuminating efficiency? At the best, our success in this direction can be only approximate. But it is to be remembered that the ability of the photometer to accurately compare the illuminating value of any two light-sources, or of any two gases burned under prescribed conditions, is not involved in this last question.

As a matter of commercial fairness, it would seem as if the comparison should be made with the gases burned in each case in a way which the consumers could easily, simply, and economically employ, and would, under those conditions, give each gas so burned the greatest possible efficiency. This would seem to point to the general use, for testing, of high-grade, though cheap, flat-flame burners.

I have thus endeavoured to touch upon some of the more important features involved in accurate photometry. Of course, we must always remember that the photometer is an instrument to be used as prescribed, and with all limiting conditions well in mind. We must see that the disc is completely protected from diffused light, and that this condition is maintained. Accumulation of dust, &c., may cause sensible error. The room should be maintained, as far as possible, at the normal temperature. The various parts of the instrument should be re-adjusted and re-standardized from time to time. It should not be taken for granted that the two lights are exactly 60 inches or 100 inches apart, and that the centre of the bar is exactly midway between the lights; that the meter is accurate; or that the candle balance is sufficiently sensitive. I have seen numbers of balances in American photometer-rooms which were attractive enough in appearance, but which were better adapted for use in a grocery than in a laboratory. The ventilation of the photometer and the room should be well cared for. An accumulation of carbonic acid from the products of combustion and an increase in temperature are prolific sources of error. The instant a disc becomes discoloured or marred, it should be replaced.

To the younger members I may, perhaps, venture to suggest that it is necessary to study photometry to be sure of results. Do not be willing to blindly follow the methods prevailing at your station.

As gas engineers engaged in the practical, every-day work of our profession, we cannot expect to do much in the way of original investigation in the science of optics. But we can keep informed as to the progress in practical photometry; and possibly we may assist the men of science in putting the results of their patient labours into more practical shape.

Before concluding, I wish to raise my voice in earnest protest against a too ready condemnation of the photometer. Before a recent meeting of a sister Association, a remark was made to the effect that the photometer could be made to give any reading to suit the prejudices of the observer. Is it not at once to be understood that, in any laboratory test, the statement of the result is absolutely dependent upon not only the accuracy of the instrument and the skill of the experimenter, but upon his honesty? Why should we expect the photometer to give accurate results irrespective of the observer's wishes?

Commercially reliable results can be obtained, and are constantly being obtained, with the bar photometer; and if they are not so obtained, the one charged with the making of the tests should be held responsible. Of course, where we get results far outside of the beaten track, it is reasonable that we should ask if these abnormal results were not obtained while some of the sources of error were out of mind. In such extreme cases, no honest investigator would object to the request for confirmation.

No doubt lack of uniformity in the instruments, and in the manipulative methods employed, adds to our difficulties; but this can be improved, not by condemning the photometer as worthless, but by recognizing its intrinsic worth, and then co-operating to make its statements more uniformly comparable. Further still, after we get our statements from the photometer, let us bear in mind that it still rests with us to properly interpret those statements. The prime importance of sending out a uniform quality of gas will be readily admitted by all. Without the photometer, how shall this be ensured?

In conclusion, I maintain that "candle-power" is a true measure of illuminating power under the conditions prescribed for the test; that the photometer can be relied upon, with confidence, to correctly measure the illuminating power of a light-source; that the total illumination and the intensity of illumination must of necessity vary with the subdivision and distribution of our light-source, and with the nature of the surrounding surfaces; that a measurement of the spherical candle power of the light-source, and a determination of its colour composition, will, as far as possible, enable us to estimate the light-effect obtainable under varying conditions; that the actual measurement of the total illumination of an enclosed space and of the different degrees of intensity of illumination is well-nigh impossible, and that our failure in this direction is no criticism of the photometer or of the principles upon which it operates; that the intensity of illumination, either of an open or of an enclosed space, cannot be made uniform by the employment of any artificial light source, but our aim should be to modify the effect of the law of distances and the spherical distribution from the light-source, so that, as far as possible, the illumination should be distributed uniformly where required; and that it should be our aim, as far as possible, to shield the eye from the direct light-rays, and so give it the fullest possible opportunity to appreciate the illumination afforded.

[In an appendix to his paper, Mr. Humphreys gave a list of standard works, extracts from gas periodicals, and other literature on the subjects of photometry and illumination.]

Making Water-Works Ornamental.—The Water Commissioners of St. Catherines (Ont.), in their report for the past year, have briefly described some of the improvements they have made in the grounds surrounding their reservoirs by planting ornamental trees, hedges, &c.; thus adding materially to the attractiveness and beauty of the landscape. They say they have considered it their duty not merely to manage the works with care and economy, and to furnish the inhabitants at all times with an abundance of good water, as well as an efficient pressure for the extinction of fires, but have also thought it incumbent to beautify and adorn the grounds; and they rely upon the refined taste and higher sentiments of the citizens for support and approval of their efforts to give the reservoirs the best setting which natural scenery and tastefully laid-out and well-kept grounds can afford.

Society of Arts.—The opening meeting of the 142nd session of this Society took place last Wednesday evening, when Major-General Sir John Donnelly, as Vice-President and Chairman of the Council, delivered an address. In continuation of his address of last year, he discussed the present position of technical instruction in this country, and reviewed what was done as a preparation for it in elementary schools, and to promote it through the Science and Art Department, as well as by voluntary associations. He then analyzed the returns as to the appropriation of the beer money and the levying of rates by local authorities, classified the subjects selected by them, and suggested that the suspicion of waste—the possible price of experience—should be met by concerted action and more systematic inspection and examination. At the close of the address, Sir John Donnelly presented the Society's medals awarded to authors of papers read last session; one being to Professor Vivian B. Lewes, for his communication on "The Commercial Synthesis of Illuminating Hydrocarbons."

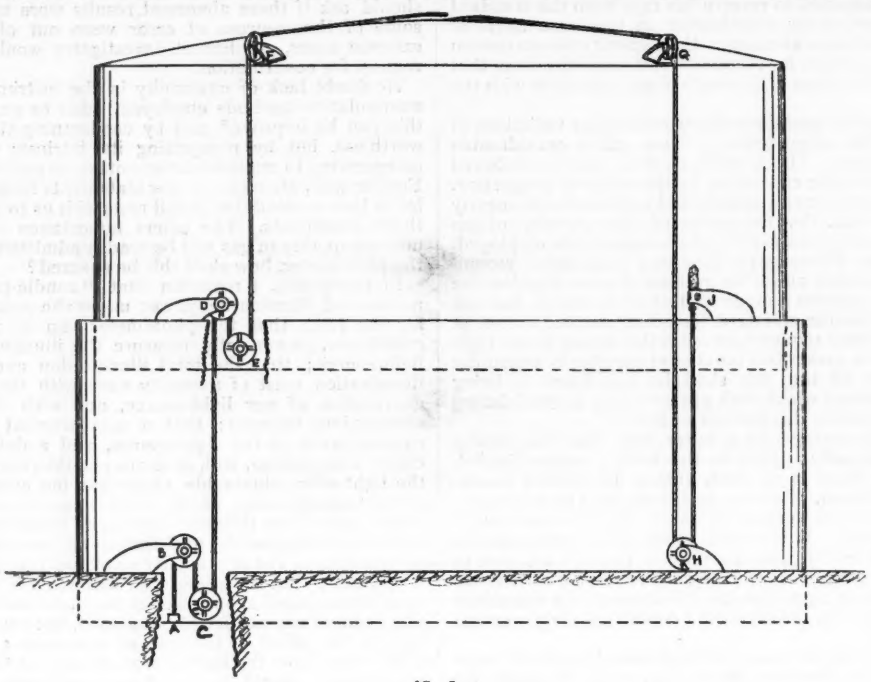
THE NEW HOLDER AT THE MIDDLESBROUGH GAS-WORKS.

In the JOURNAL for the 29th ult. (p. 884), we gave some particulars, supplied by Mr. David Terrace, the Gas Engineer to the Middlesbrough Corporation, in regard to the new holder with the wire-rope system of guiding lately erected at the works under his supervision. We are now able to supplement those particulars by other details furnished by the manufacturers (Messrs. Ashmore, Benson, Pease, and Co., Limited), and to give a view of the holder fully inflated, and diagrams showing the method of training the ropes.

The main feature of interest regarding this holder is the fact of its being the largest erected up to the present time without the usual guide-framing; and it may be remarked at once that the system of rope control has proved itself capable of maintaining the holder in an absolutely level condition, or, speaking more correctly, within half an inch. This was found to be the full amount of variation from the dead-level when the holder was inflated to its full height and standing during a gale of wind, and working without any vibration or irregular movement. The pressure-register also supplies an excellent diagram as to the regularity of pressure in the rise and fall.

Work on the tank, which is 186 ft. 6 in. diameter and 31 feet deep, and composed of steel plates, was commenced in the beginning of December last year; water being turned in the first week of the following October, and the holder inflated on the 15th of that month. It may be mentioned here that the contract was signed on Oct. 12, 1894, and Messrs. Ashmore were allowed sixteen calendar months for the completion of the work. They are therefore more than six months in advance of their time.

There is little to be noted with regard to the holder itself, as the design varies very slightly from that usually adopted, with the exception that a certain number of guides, with corresponding carriages, are placed on the outside. These prevent any twisting motion to which there may be a tendency by the action of the wind. The method of supplying the rope support, however, illustrates a development which has not previously been adopted—viz., the feature of the utilization of the power that is obtainable by the use of suitably placed pulleys. By this means, the twelve ropes that pass over the inner lift have, broadly speaking, the effectiveness of twenty-four ropes when applied to the second lift. The outer lift is roped quite independently of the two inner lifts. It is supplied with eighteen ropes for the support of the bottom curb, and eighteen ropes for the anchoring (if it may be so termed) of the dip of the outer lift, on the same principle as that applied to the second lift. The thirty-six ropes on the outer lift (or, more correctly speaking, eighteen, seeing that each rope acts in a double capacity in controlling the dip at one extremity and the bottom curb at the other) possess a gross aggregate effectiveness of seventy-two ropes.



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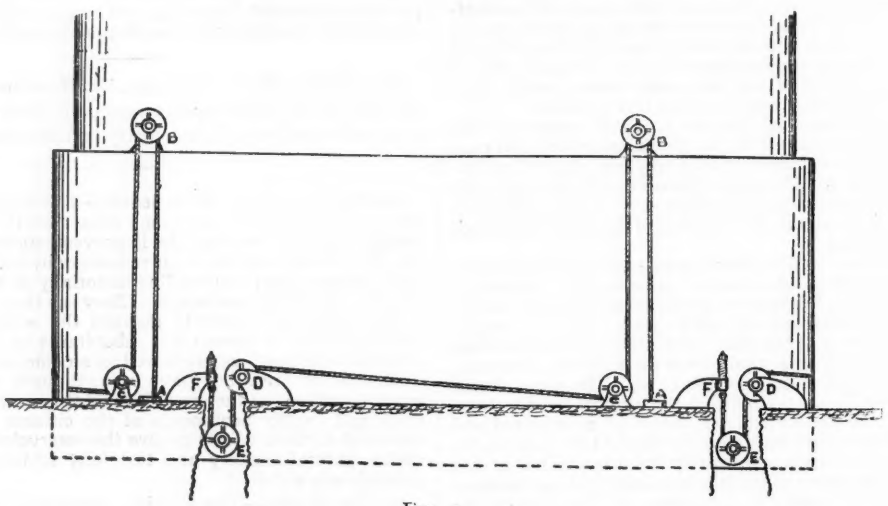
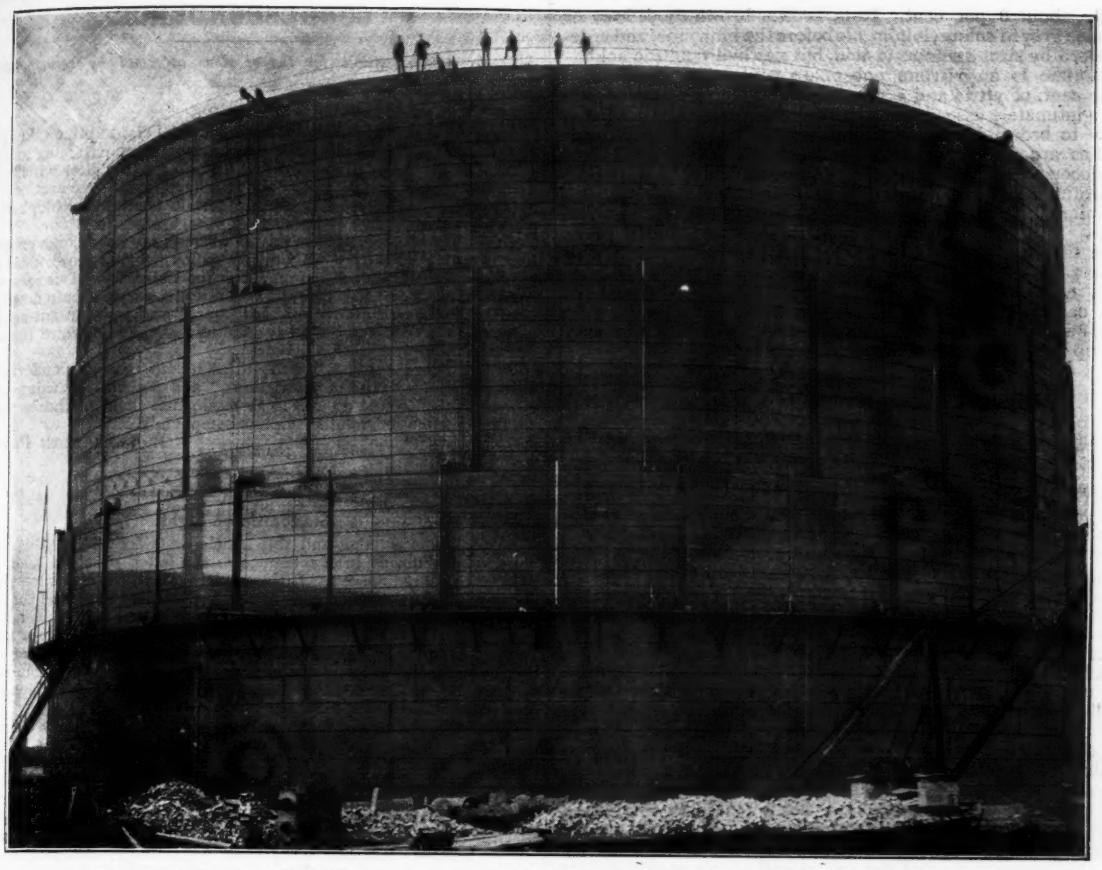


FIG. 2.

The accompanying diagrams are in no way correct in detail, but merely indicate the position of the pulleys and brackets in regard to one another. Fig. 1 illustrates the two inner lifts. The ropes cross the centre of the crown, and are attached at either end in the manner shown by the two portions of rope which combined form one complete rope. As the inner lift rises, E approaches D, while G leaves H. When the outer lift rises, the two points A and C approach B, while the two points



ROPE-GUIDED GASHOLDER AT THE MIDDLESBROUGH CORPORATION GAS-WORKS.
Capacity, 2,250,000 cubic feet. Tank, 186 ft. 6 in. diameter, 31 ft. deep.

G and J leave H. The traverse of each rope is thus twice as rapid, and the support it is qualified to afford double as great, as in its passage over the inner lift. Perhaps it is hardly necessary to remark that a minimum of three ropes is necessary.

Fig. 2 does not show the horizontal pulleys that are required to carry the ropes round the circle of the holder. The number of parallel ropes on these pulleys will vary according to the distance apart of the two ends of the ropes, and the number of ropes employed. In the present case there are four, which run for a certain distance in company. The essential principle of the arrangement is plainly shown in the diagrams, and needs no further elucidation. Attention may, however, be drawn to the means of adjustment, and to the springs on the tops of the brackets. Ample margin is left for tightening the ropes if required; and the effect on its neighbour of tightening one rope, owing to their juxtaposition, is very clearly shown. A, C, D, and F are all fixed to the tank.

In all cases the brackets of the pulleys on the holder that receive the strain of the ropes are firmly attached to strong vertical stays on to the ironwork of the curbs, or cups and dips, in close proximity. Intermediate between the eighteen stays carrying the pulleys corresponding to those marked B in fig. 2, are thirty-six stays of lighter section. While the vertical stays provide for the stiffening of the outer lift, they also, to some extent, secure its vertical rise. Opposite to the thirty-six exterior vertical stays, corresponding pulleys are placed on the top of the tank. These, in conjunction with the tank-guides, have, irrespective of the ropes, a controlling power, which, however, decreases as the holder rises.

NORWEGIAN MINERALS CONTAINING THORIUM AND YTTRIUM.

The following is an abstract-translation of an article on the above subject by Herr L. Schmelck, which appeared in the *Zeitschrift für angewandte Chemie*, and has been reprinted in *Der Gastechniker*.

Norway is one of the chief localities for the minerals containing thorium and yttrium oxides and the allied rare earths, which are used for incandescent lighting. Several of these minerals have been but little examined; and the text-book statements concerning them are unreliable and deficient. Since there is now a great practical application for them, the following information, based on the author's own observations, may be of service.

The following are the more important Norwegian minerals which serve as raw materials for the oxides: Thorite, orangite, aeschynite, euxinite, fergusonite, monazite, gadolinite, orthite, xenotime, and yttrotitanite. Thorite, a thorium silicate containing about 50 per cent. of thoria as well as uranic and ferric oxides, lime, and small amounts of ceria and yttria, and orangite, which contains about 70 per cent. of thoria besides the other constituents of thorite, have no precise differences, and are varieties of the same mineral—being often found in contiguity. Thorite is chestnut brown to pitch-black in colour; more rarely touched with green, fracture conchoidal, and streaked with brown. Orangite varies in colour from orange red (in the purest varieties) to brownish black, and is diaphanous and lustrous. Thorite and orangite are of the hardness of apatite, and are infusible before the blowpipe; thorite becoming brown, and orangite white in the flame. Both minerals are easily and completely taken up by concentrated hydrochloric acid. On diluting the solution with its volume of water and boiling, the addition of ammonium oxalate immediately throws down characteristic quadratic tabular crystals of thorium oxalate. Commercial thorite and orangite usually contain only 45 to 60 per cent. of thoria.

Aeschynite and euxinite resemble one another externally, and have nearly the same constituents—viz., earths of the yttria group, titanic and niobic acids, uranic oxide, ceria, and thoria. There is usually 10 per cent. of thoria in aeschynite, and only 3 to 4 per cent. in euxinite. Both minerals are brownish-black to black in colour. They are only slightly attacked by strong hydrochloric acid, but, if finely powdered, are gradually dissolved in concentrated sulphuric acid. They are infusible before the blowpipe. Fergusonite (yttrium tantalate, with about 30 per cent. of yttria) resembles these minerals in outward appearance and solubility. Gadolinite contains about 45 per cent. of oxides of the yttrium group, and about 25 per cent. of silica, as well as the oxides of iron, beryllium, lanthanum, and cerium, and small quantities (0·5 per cent.) of thoria. Orthite—an aluminium-iron-calcium silicate, with about 20 per cent. of the oxides of cerium, lanthanum, yttrium, and didymium, and small quantities of thoria—closely resembles gadolinite in appearance. Both are ordinarily quite black, streaked with grey or brown. Before the blowpipe, orthite swells up considerably and melts; while gadolinite swells but little, and is infusible. Orthite is generally readily soluble in concentrated hydrochloric acid; gadolinite usually requires strong sulphuric acid for its solution.

Norwegian monazite (lanthanum-cerium-didymium phosphate) contains from 3 to 12 per cent. of thorium oxide—

usually about 8 per cent. It is brown, brownish yellow, or brownish grey in colour, is infusible before the blowpipe, and is decomposed by strong sulphuric acid, but not hydrochloric acid.

Xenotime is an yttrium phosphate containing about 50 to 60 per cent. of yttria and erbia, as well as ceria. It generally occurs intimately associated with other rare minerals; and it is yellow to brown in colour, and infusible. Some of the purer varieties are soluble in strong hydrochloric acid; others are only decomposed by concentrated sulphuric acid.

Yttrotitanite, or keilhauite, is a titanosilicate of calcium, aluminium, and iron with 6 to 12 per cent. of yttria and allied earths. It is black in colour, and intumesces; and it melts before the blowpipe. It is decomposed by concentrated sulphuric acid, but very little by hydrochloric acid.

The other Norwegian minerals containing thoria and the yttria earths—such as tritomite, pyrochlor, polymignite, polycrase, eucrasite, &c.—occur in such small quantities that they have up to the present no practical importance.

SUPPLYING GAS WITHOUT A HOLDER.

In another part of the JOURNAL will be found a communication from Mr. G. E. Stevenson, of Manchester, furnishing particulars, in answer to an inquiry by a correspondent, of a case which came within his experience of keeping up a supply of gas without a holder. An instance of a somewhat similar kind occurred a few years since to Mr. J. W. Dunbar, of New Albany, Ind., who gave an account of it in a paper submitted to the Western (U.S.A.) Gas Association. An abstract of the paper appeared in the JOURNAL at the time; but it may be interesting to reproduce it in conjunction with Mr. Stevenson's article.

The holder in question—the only one on the works—had a capacity of 60,000 cubic feet; and the supply of gas had to be kept up while it was undergoing repair. The maximum output per diem was 75,000 cubic feet; and the minimum 21,000 cubic feet. It was, of course, during the period of minimum make that the gas was supplied without the holder—direct communication being effected between the inlet and the outlet. The inlet and outlet pipes were 2 feet apart inside the holder, and both 10 inches in diameter. The outlet had been abandoned for several months, on account of the leakage of water at the joints; and the inlet was also admitting water to an alarming extent. The condition of the seams and rivets in the holder was very bad, as the leakage amounted to 20 per cent. of the gas produced. Commencing operations on a Monday, the first thing was to empty the tank. Some adjacent low ground enabled about half of the contents to be syphoned off by means of two 3-inch syphons; and the remainder was pumped out by the aid of the city fire-engine. On the following day, Mr. Dunbar was able to inspect the inside of the holder; and it was then found that the lead joints of the stand-pipes had become loose. They were well caulked, and this stopped the leakage, which did not occur again. Mr. Dunbar could only account for this defect by the extreme cold, which ranged to 15° below zero in the winter, as the leakage commenced during a spell of severe weather. Turning to the holder seams, it was found that many of the rivets had not been properly set up in the first place. An ordinary knife-blade could be introduced at many points. These places were filled up with a putty composed of litharge and red and white lead, worked up with glycerine; and the whole of the seams, inside and out, were thoroughly painted with the mixture. This method proved to be a satisfactory cure; and on being again put into use, the holder was perfectly sound. Having previously tried all sorts of expedients on the outside of the holder, to render it tight, the author formed the opinion that a leaky holder could not be made sound from the outside.

No difficulty was experienced in keeping up the supply of gas, except for a short time on the first night. The amount of pressure required was 12-10ths; and as the evening of the first day came on, the retorts, which had been standing empty, were set to work. A sufficient number were charged to bring up the pressure to 3 inches. But it soon fell off from this; and before the remaining retorts were charged, it had fallen to 5-10ths. The charging being completed, it went up to 2 inches. After this a momentary decrease of pressure was caused by a stoppage in the washer, which had to be at once bye-passed. With this experience, a better start was made on the following evening—the pressure being run up to 5 inches at first; and some of the retorts were drawn and recharged as soon as the pressure fell to 2 inches. This was continued through the night. The street-lamps were not lighted except on one night, and then only for a few hours. Without the public lamps (475 in number), a make of 8000 cubic feet of gas per hour was sufficient; with them, 11,000 cubic feet per hour were required. But with this extra demand, a pressure of 13-10ths was maintained. No complaint was received from consumers, as the illuminating power of the gas was kept slightly above the usual standard.

The Leeds Gas Committee and Retort-House Machinery.—The Gas Committee of the Leeds City Council have arranged to visit the East Greenwich station of the South Metropolitan Gas Company and the Brentford Gas-Works, to inspect the installations there of retort-house machinery and inclined retorts, with a view to their adoption in the Meadow Lane works extensions.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Carburetting.

SIR,—As it appears likely, unless a material rise in price takes place, that benzol will largely displace "carburine" as an enriching material, it may not be out of place to direct attention to a matter which so far does not appear to have been duly considered in this connection—viz., that commercial benzol may contain carbon bisulphide, thiophen, and possibly other sulphur compounds.

Of the samples which have passed through my hands, one contained as much as 972 grains of sulphur per gallon, which is equivalent to an increase of 10 grains of sulphur per 100 cubic feet of gas for every candle of enrichment. It is, however, not a very difficult matter for distillers to materially reduce this figure; and upon attention being directed to the subject, benzol containing less than one-third the above amount of sulphur was obtained.

It is perhaps needless for me to point out that gas undertakings working under "sulphur restrictions," and desirous of using benzol as an enricher, would do well to ascertain that their purchases contain no large amount of volatile sulphur compounds.

E. LLEWELLYN PRYCE.

Windsor Street Gas-Works, Birmingham, Nov. 22, 1895.

Standards of Light.

SIR,—The interesting and able article by "Veritas" on this important subject makes brief reference to the letter from me which you inserted a short time ago. I join with "Veritas" in regretting that so large a subject obtains so little notice, and fall into the belief that there is not such an urgent demand for a change of standard as some have said exists. In fact, I think that "to leave well alone" is a general feeling, because of the noticeable advances in accurate testing by means of candles of late years, and secondly the cautious conclusions of the last Royal Commission made an impression whose influence has not yet left us.

The improvements in the make and use of candles entitle me to say that much of the odium which condemned them years ago has been removed. The late Mr. F. W. Hartley contributed largely to the better employment of candles by arranging a candle-balance so that they might be weighed in position and whilst burning; and since his time their composition, and the weight and number of strands in the wicks, have been brought under scientific control. How great a contrast is this to what was practised only fifteen years back—viz., one candle of uncertain make and number of strands weighed before being lit and snuffed and trimmed during burning. Although so much has been done, the recent Committee took candles by their past reputation, and rushed into action as if determined to reach conclusions without fail. And yet they had less reason, in the light of present day practice, to condemn candles and to adopt the Harcourt pentane standard than had the Royal Commission of twelve years ago, which (wise and cautious in its generation) refused to do one or the other. The recent Committee helps itself over the practical defects of the one-candle pentane lamp by adopting Mr. Dibdin's ten-candle lamp, which seems to me a very lame and doubtful step for a body of scientific gentlemen to take. This is so, because though the pentane standard may give quicker results than are obtained by candles, the showing of the Committee is that the results need not be more accurate; and if time calls for quick determinations, we have in the Methven screen a standard which I have found fairly accurate, and believe is so for all qualities of gas within the range of public gas supply in this country.

I have used both the one-candle pentane lamp and the ten-candle, and agree that the first is unsuitable for general use. I further think that more difficulty lies in fixing the disc upon the neutral point at the position of the ten-candle standard than at that of two, and certainly the smaller length of movements of the disc upon the bar to declare the one-candle value is a further drawback. I do not think that a liquid or gaseous standard can compare in general usefulness with a solid one; and I believe that as a candle determination of value appeals so strongly to public sentiment, by giving a demonstration of value which is satisfying to popular claims and expectation founded upon long usage, so at present there is much less need for a change in the standard of light than for a change in weights and measures to the metric system, which a distinguished member of the present Government (Mr. Balfour) has so strongly condemned.

The writer of the article in question says that with candles, honest 16-candle gas can be anything between 15 and 17 candles. I do not think so; and the returns of the Chief Gas Examiner for London do not show it. The constancy of the published reports leads me to believe that the Gas Companies are much more likely to send out inferior gas than that the tests of the Gas Examiners are inaccurate. I must urge my former plea, that one certain make of candles only be sanctioned by the Board of Trade; and I believe this course is more likely to meet with general approval than the change recommended by the recent Board of Trade Committee.

E. WILLIAMS, F.C.S.

Manchester, Nov. 23, 1895.

Secretaries as Members of District Associations.

SIR,—I have read with interest (as I always do your admirably authentic reports) your account of the meeting of the Southern District Association of Gas Engineers and Managers; and, from remarks made in the discussion on the proposed amalgamation of this with the South-Western Association, I—as one of the "pure and simple"—would like to ask why so much stress was laid upon the matter of allowing secretaries of gas undertakings to become members of the Southern Association, as it appears that the South-Western Association by their allowing secretaries to participate in the privileges of their society have raised a barrier to their amalgamation with their brothers, the Southern Association.

There may be some grave reasons for not countenancing "pure and

simple" secretaries; but, in my simplicity, I fail to see one. Surely, we are all interested in one and the same object—self and mutual improvement, to better enable us to manipulate and carry out the responsible and onerous duties which devolve upon both engineers and secretaries in the judicious conduct of the affairs of modern gas industries.

The Institution of Gas Engineers admit, as Associates, "pure and simples;" and, so far as I know, they have not detracted from, if they have not added to, the dignity of that society. Could not, therefore, the Southern Association follow so worthy a precedent?

Nov. 21, 1895. A "PURE AND SIMPLE."

Keeping Up the Gas Supply without a Gasholder.

SIR,—Your correspondent "Storage" will be glad to know that his idea has been practically carried out; and, by working as he proposes, he will be quite safe. At the same time, such a plan should only be adopted when there is no better way of accomplishing the work.

In many years' connection with the smaller gas-works, I have had sometimes to resort to the method "Storage" proposes. Upon one occasion, the existing holder tank had to be enlarged—there being no other room for extension; and in this case an annular excavation was made round the old tank, and the wall of the new tank was built before the holder was taken out. The water, however, was pumped down, at the commencement, to within about 20 inches of the bottom—thus giving very little working room for the holder. Still it was worth having. While the holder was being taken out and the new one put in, gas was supplied direct from the retorts to the town.

There are small portable holders to be had from some of the makers, which are useful in such cases to pass the gas through. But in the absence of them, we clear out one of the purifiers, unshackle the cover and weight it to the required pressure. This will act as a safety-valve should the retorts at any time make faster than the consumption. With watchful care, however, there will be little gas lost here.

As it may be, perhaps, a small day consumption, "Storage" will find an advantage in having at hand for the occasion a very slow working coal for the day charges. Of course, no exhauster will be worked; and there are reasons why the governor will be best, either bye-passed or loaded out of action for the time.

Rhayader, Nov. 19, 1895. W. H. MORGAN.

Proposed Association of Water-Works Engineers.

SIR,—We are again reminded by the "Water Companies' Directory" that "there is no institution wholly given up to water engineering questions in England, although such questions are occasionally treated of by the Institution of Civil Engineers." That is, I am led to understand, the opinion of many engineers, managers, and others connected with water undertakings. The exceptional and severe winter of 1894-5 itself was a subject-lesson to those interested in water-works. The controversy as to the use of two-gallon or three-gallon cisterns for water-closets, the question of the employment of registered plumbers only for water-works purposes, and the better control of fittings for the prevention of the waste, misuse, and contamination of public supplies, are points, among others, which might usefully engage the attention of, and call for combined action from, those who are engaged in this important branch of engineering; and my object in writing is to initiate a discussion by those interested, with the view of ascertaining what support is likely to be given to such an Association as the one suggested.

Nottingham, Nov. 16, 1895. D. M. F. GASKING,
Engineer, Nottingham Corporation Water-Works.

A Public Lighting Difficulty at Newport (Mon.).—Last Wednesday the Lighting Committee of the Newport Corporation had a conference with representatives of the Gas Company, with the object of adjusting a difficulty which has arisen in consequence of the Corporation giving the Company notice that they would not want gas for the 50 or 60 Sugg lamps in the area of the electric light installation. The Company were given notice of the intention of the Corporation twelve months ago; but it was contended that this notice had lapsed. On behalf of the Company, it was asserted that the Sugg lamps were a source of profit; whereas from the ordinary street-lamp, at £2 17s. 6d. per annum, no profit was made. Ultimately a compromise was effected, by which the Committee agreed to recommend to the Corporation to pay for the 50 or 60 Sugg lamps up to Dec. 1, or seven weeks beyond the time they had been needed. The Company abandoned a demand that the Corporation Road and other areas should be lighted, in order to bring the quantity of gas burned in public lighting up to the standard contracted for.

A Sensational Trick Explained.—A correspondent sends us the following: A great sensation has been caused on the Continent by the performance of two men, styling themselves "The Great Fire Kings," who stood on an open stage and, without any visible apparatus, caused long brilliant flames to dart from the tips of their fingers, and also from their mouths, for nearly a minute at a time. The trick is now accounted for. "The Great Fire Kings" stood on a daïs, seemingly designed to lift them into plainer view, but really concealing two rubber bags filled with coal gas, and compressed by heavy weights. To the heel of each man's right shoe a contrivance was fixed which, when pressed, joined a nozzle on the gas-bags, and opened the passage for the gas to escape through a tiny tube carried up the leg and back and down both sleeves—a connection being made at the wrists with flesh-coloured tubes, which traversed the palms of the hands, and terminated at the tips of the fingers, while another flesh-coloured tube was arranged to end by the chin. The ignition was brought about by an electric spark; and it was the failure of this spark to work at one of the *séances* which brought about the exposure of the trick. An escape of gas resulting, there was a small explosion, which blew up the daïs and slightly injured these ingenious "sons of fire," or should we not say "gas consumers?"

LEGAL INTELLIGENCE.

Action to Recover Possession of a Foreman's Cottage.

At the Bromley County Court last Tuesday, the Bromley Gas Consumers' Company brought an action to recover possession of a cottage, and rent for same, from a man named Bennett. Mr. Gregory stated that the defendant was formerly employed by the Company as foreman; and the occupation of the cottage was part of the remuneration paid for his services. On Sept. 14, he was told his services were no longer required; and he was given £12 in lieu of notice and the cost of removing his furniture back to Manchester. Defendant had refused to quit, although he took the £12; and the Company wanted the cottage for their new foreman. Judge Emden said the defendant might, as he had alleged, have a grievance against the Company; but he had no right to hold the cottage after his discharge. The defendant must give up possession at once, and pay 30s. for his occupancy of the place since his discharge.

Theft of Cannel Coal.

At the Tenterden Petty Sessions on Saturday, Ambrose Rose, an engine driver, was charged with stealing 7 cwt. of cannel coal, value 9s. 9d., the property of the Tenterden Gas Company. Mr. W. T. Mercer, the Secretary of the Company, said the defendant was delivering coal at the gas-works for the Contractors, when he was seen by the Manager (Mr. S. E. Bark), who asked him about the coal which was in the tender of the traction-engine in his charge. Mr. Bark's attention was first attracted by the smell of cannel coal burning; and before the defendant was spoken to, the gas-works were examined—it being thought that there was an escape somewhere. Mr. J. E. Mace (the Chairman of the Company) was communicated with, and a prosecution ordered. The defendant said he had run short of coal for his engine, and he had tried "a little of the cannel." When the tender was examined 7 cwt. 20 lbs. of coal was found—there not being more than a shovelful of ordinary coal in it. The excuse was that the defendant, having run short of coal on the journey, thoughtlessly took some of the cannel coal. A fine of £5 was imposed.

The Public Lamp Meter Question at Dublin.

In the High Court of Justice, Ireland, last Tuesday, the Master of the Rolls again had before him the application for attachment by the Alliance and Dublin Consumers' Gas Company against the Corporation of Dublin (see *ante*, p. 1041). The Solicitor-General, with whom was Mr. Blood, on behalf of the Company, said this was an application that a time should be limited for compliance by the Corporation with the order of the Court of July 6, 1895. By that judgment, it was ordered that the Corporation should remove defective meters from the public lamps, and provide in lieu thereof proper meters within the award between the Corporation and the Company. A case had been submitted on behalf of the defendants to Serjeant Campion to advise as to whether there ought not to be an appeal. He understood the Corporation were not going to take any further proceedings; and the question now was what time ought to be given for the removal of the meters. He would suggest three months. Mr. C. O'Connor, Q.C., said the Corporation did not intend to appeal; and it was their desire to carry out his Lordship's order with the utmost expedition. The fixing of the old meters extended over a period of sixteen months; and his instructions were that it would be impossible to carry out his Lordship's order in three months. What he proposed was that the Corporation should give an undertaking that they would proceed to carry out the order with the utmost expedition; and, on this undertaking, that there should be no rule on the motion, with liberty to plaintiffs to re-enter it, if necessary. The Master of the Rolls said there did not appear to be any disposition on the part of the plaintiffs to unduly press the matter. The suggestion was that three months would be a reasonable time. He thought, perhaps, it would be better to give the Corporation four months, on the understanding that, if they used diligence and could not comply with the order in the time, they could apply for an extension, which, if necessary, would be favourably considered. The Gas Company (who, it was stated, were perfectly satisfied with the decision) were given the costs of the motion.

New Sewage Purification Works at Chorley.—The Corporation of Chorley have just completed their new sewage purification works at Common Bank farm, at a cost of about £15,000; and Alderman Hibbert, the Chairman of the Sewage Committee, performed the opening ceremony on the 28th ult. The works have been designed by the Borough Engineer, Mr. William Leigh, Assoc.M.Inst.C.E.; and the whole has been carried out under his direction. The "International" is the process adopted. Mr. Leigh has provided tanks of a total capacity of 1,120,000 gallons; and "Polarite" filters of a total area of about 1500 square yards. The sludge pressing machinery has been supplied by Messrs. Goddard, Massey, and Warner, of Nottingham. These new works have been rendered necessary by the fact that the Chorley sewage farm has failed in producing an effluent to satisfy the requirements of the river authorities. At the conclusion of the opening ceremony in the town hall, Mr. Brierley, C.E. (Messrs. Brierley and Holt, of Blackburn), speaking in response to the toast of the "Visitors," said that, as an engineer of 40 years' experience, and one who held a public office for many years, he was able to judge of the labour involved in carrying out works of the kind they had seen opened that day. He had witnessed all the phases of the great sewage question; and the system of treatment adopted at Common Bank represented the last, the latest, and the most complete development. They had seen in what an efficient manner the work had been carried out; and he thought he should not be doing an important duty to a professional brother if he did not say that there was no part of the work which was not of a sound and practical kind, and that the whole had been admirably conceived and executed.

MISCELLANEOUS NEWS.

SOUTH METROPOLITAN GAS COMPANY.

The Conversion of Capital and Workman-Director Schemes.

The South Metropolitan Gas Company have given notice of their intention to re-introduce their Bill of last session dealing with the above-named schemes, but with certain modifications. The nature of these will be gathered from the following extracts from the notice setting forth the objects of the Bill:—

1.—To convert the capital of the Company, other than debenture stock, into a capital of the same or different classes, having a uniform standard rate of dividend of £4 per cent. per annum on the nominal value of such converted and consolidated capital (subject to decrease or increase with the increase or decrease of the standard price of gas) or such other standard rate of dividend as may be defined by the Bill or prescribed by Parliament; and to allocate such capital to and among the holders of the different classes of stock and shares, and to secure to them respectively the same amount of dividend in every year as that to which they would respectively be entitled in case no such conversion had taken place, or such other dividend as may be agreed on between the said classes, or defined by the Bill, or prescribed by Parliament.

2.—To make provision for the surrender and cancellation of the existing stocks, and the certificates therefor, and for the issue to, and the acceptance by, such holders of the new stock and certificates in exchange for their existing stock certificates.

3.—To empower the Company, for the purposes aforesaid or any of them, to increase their nominal capital, and substitute an equivalent amount of stock of the same or different classes, and entitled or not to any special right or privilege as to participation in dividend, if and when it exceeds the standard rate, and to allocate such capital accordingly.

4.—To enable the Company, by agreement with the holders of any stock of the Company, to alter the dividends payable thereon so as to make the dividend on all or any classes of shares and stocks equal; and to confirm any such agreement which may have been, or which during the progress of the Bill may be, entered into.

5.—To empower the Company, for the purposes aforesaid, to purchase for cancellation, and to cancel, £2333 6s. 8d. of their "A" stock, or such other amount as the Bill may define or Parliament prescribe; and to appropriate out of their reserve fund such a sum as will be necessary to effect such purchase.

6.—To convert or provide for the conversion of the existing 5 per cent. debenture stock of the Company into such larger nominal amount of substituted debenture stock entitled to interest or dividend after the rate of £4 per cent. per annum, or such other rate as may be defined by the Bill, or prescribed by Parliament, as will yield the same amount of interest or dividend thereon as does the said existing debenture stock; and to provide that the remainder of the authorized but unissued debenture stock shall, after the creation and issue thereof under the provisions of the Acts whereby it is authorized, be converted into such nominal amount of substituted debenture stock (entitled to the same rate of interest or dividend as the debenture stock into which the existing stock shall be converted) as to yield to the holders of such substituted debenture stock the same amount of interest or dividend as the debenture stock for which it was substituted, and to make provision for the surrender and cancellation of the certificates of all debenture stock so converted, and the issue to, and acceptance by, the holders of such stock of the substituted debenture stock to be issued in exchange therefor.

7.—To empower the Company to purchase compulsorily or by agreement certain lands situate in the parish of St. Alphege, Greenwich. [Particulars as to these lands follow.]

8.—To make provision, either in the Bill or by a scheme to be submitted to, and approved by, the Board of Trade, with respect to the investment by persons in the employ of the Company in the capital of the Company, and for their representation in or upon the management of the Company, and for prescribing the rights, privileges, conditions, and restrictions under and subject to which such representation shall be given; and to confer on the Board of Trade and the Company all such powers as may be deemed necessary or expedient for effecting the objects aforesaid.

9.—To alter, or provide for the alteration of, the scale of voting of proprietors at meetings of the Company.

10.—To make provision for the offering to consumers of gas of the Company, and to persons employed by the Company, of new stock of the Company at the then market price of their existing stock.

11.—To authorize the signing of warrants for dividends on the stocks and for interest on the debenture stock of the Company by one Director only of the Company.

12.—To confer on persons in the employ of the Company, and holding stock of, or having deposited money with, the Company, the like power to nominate persons to receive such stock or money as is possessed by depositors in the Post Office Savings Bank; and to confer on the Directors of the Company the like powers of transfer and payment of such stock and deposited money as is possessed by the Directors or Committee of Industrial and Provident Societies and Savings Banks.

13.—The Bill will repeal, alter, and amend all such rights and privileges as would interfere with any of its objects, and will confer other rights and privileges, and will repeal, alter, and amend, and, if thought fit, consolidate all such provisions as may be thought necessary or expedient of the following Local and Personal Acts (that is to say): 5 Vict., cap. 79, sec. 2, City of London Gas Act, 1868, and the Schemes of Amalgamation made thereunder; the South Metropolitan Gaslight and Coke Company's Act, 1869; the South Metropolitan Gaslight and Coke Company's Act, 1876; the South Metropolitan Gas Act, 1881; the South Metropolitan Gas Act, 1882; and any other Act or Acts relating directly or indirectly to the Company or their undertaking. It will also incorporate with itself, *in extenso* or by reference, with or without alteration, such of the provisions as may be deemed expedient of the Lands Clauses Acts, the Companies' Clauses Consolidation Act, 1845, the Companies' Clauses Act, 1863, the Companies' Clauses Act, 1869, the Post Office Savings Bank Acts, 1861 to 1891, the Savings Bank Act, 1887, and the Acts relating to Industrial and Provident Societies.

THE DISASTROUS EXPLOSION IN THE STRAND.

On Monday last week, Mr. JOHN TROUTBECK, the Coroner for Westminster, continued his investigation, at the St. Clement Danes Vestry Hall, into the cause of the death of Martin Ernest Sprague, a member of the Metropolitan Fire Brigade, who sustained injuries which proved fatal while searching the ruins on the scene of the explosion in New Church Court, Strand, on the 29th ult.

On the present occasion, the Hon. ALFRED LYTTELTON appeared for The Gaslight and Coke Company; the other interested parties being represented as before.

Evidence was first called to controvert the allegations made at the opening of the inquiry as to the condition of the houses which were destroyed—the principal witness being Mr. *A. O. Collard*, a Surveyor. His testimony was to the effect that the bricks of which the houses were constructed were old London red bricks, kiln burnt; that the mortar, which was composed of chalk lime and sand, was very good; that the walls were of greater thickness than was now required by the Building Act; and that altogether the houses were solidly built. Witness was present at the opening of the ground in the court on Nov. 11; and then saw a fracture in the gas-main. In his opinion, the explosion was caused by the percolation of gas through the loose earth into the basement of No. 26, where it accumulated, as the cellar was practically sealed up. In the vault of No. 27, he had found a crack running about 16 feet of the whole length of 22 feet of the front wall; and it then turned round the angle of the wall separating the vault from the basement of No. 26. This wall was pushed inwards about 3 inches; and the fracture showed evidence of being new. Some external force, he supposed, must have pushed the wall in. From inquiries he had made, he learnt that the shock was felt some 800 or 900 feet away.

Mr. *Roland Plumbe*, Mr. *Robert Walker*, and Mr. *F. W. Porter*, District Surveyors, and Mr. *G. Bywaters*, a builder, gave corroborative evidence as to the construction of the houses.

Mr. *W. G. Cannon*, a gas and hot-water engineer, stated that he had examined the fractured gas-main. Judging from the rust, he thought one part of the fracture was rather aged; but the principal part was of only a few days' standing. The rest of the pipe seemed to be sound and perfect. In his opinion, at the time the main was tapped for the purpose of forming a junction for the service-pipe leading into Loveridge's restaurant, a very small fracture might have occurred, but not large enough perhaps to detect an escape of gas. But such a fracture would extend in course of time. The brickwork which supported the step of No. 26 was of rather a light character; and gas could easily have percolated through the earth, and into the basement of the house.

By the Hon. A. LYTTELTON: Witness was not aware that the pipe was laid in 1879. Assuming that water had percolated through the ground for a fortnight previous to the explosion, that would have caused rust, but not to the extent that the rust had eaten into the fractured parts.

Philip Watson, a workman in the employ of the New River Company, stated that he was called, on Oct. 25, to attend to a leakage of water into Loveridge's kitchen. On the following day, they opened the asphalte and cement pavement opposite No. 25; and there found a hollow some 15 feet long by 6 feet wide, and 2 feet deep. This was quite 20 feet from where the fracture in the gas-pipe was discovered. The gas and water pipes were lying about 12 inches apart; the latter being about 2 feet deep, and the former 8 inches nearer the surface. There was no smell of gas in the hole. When they detected an escape, they always gave information to the Gas Company.

Replies by witness to some questions by the Hon. A. LYTTELTON showed that the water escaping from the fractured main must have flowed down the court in a southerly direction, past the spot where the gas-main was fractured, to reach Loveridge's kitchen and the machine-room of the *Weekly Times and Echo*. He confessed that he smelt gas in the court, but not in the trench; but as there was no escape from the portion of the gas-main which he exposed, he did not think it necessary to give information to the Gas Company.

By Mr. DEBENHAM (for the New River Company): For reporting an escape to the Gas Company, he would receive a reward.

Mr. *G. F. L. Foulger*, the Distributing Engineer of The Gaslight and Coke Company, deposed that no complaint had been made to him as to an escape in New Church Court before midday on Monday, Oct. 28. Immediately upon receiving information that an explosion had taken place, he himself went to the court. The gas was, as quickly as possible, cut off at the main; and temporary lights were fitted up to enable the firemen to carry on their operations. The place was left undisturbed until the visit of various gentlemen interested in the matter on the 11th inst., on which day the ground was opened, and the water and gas mains exposed. The average depth of the gas-main was 2 feet; and the water-main was 10 or 12 inches below. This was an exceptional depth for a gas-main in a court where there was no vehicular traffic. The main was laid in 1879; and, in such soil, its life ought to be 50 years. The trench which they opened on the 11th inst. was about 27 feet in length. They found the soil was loose, and had the appearance of having been thoroughly washed with water. The gas-main was practically unsupported, and acted as a kind of girder to the footway above. It was discovered that the gas-main had been fractured immediately where the service entered Loveridge's kitchen. The main was completely broken; and there was considerable depression in it at the fracture. It took seven pennies on one side of the depression and five on the other to adjust a spirit-level. This great depression, in his opinion, was due to the falling of some of the brick-

work immediately after the explosion. He thought that, before the explosion, the main was simply cracked without the depression, and that the crack was caused by the soil being washed away. He was quite certain the crack was of recent date, from the fact that the escape from it would have been equivalent to 50 cubic feet an hour, and more than that at times of greatest pressure; and such an escape could not continue without being detected. Taking into consideration the quantity of water that must have percolated through the ground, and passed round the fracture, as well as the amount that was poured on to the ruins at the time of the fire after the explosion, there was no more oxidation at the fractured ends than he would have expected to find in the case of a recent fracture. Besides, the pipe had been lying in the wet soil from Oct. 29 to Nov. 11 before being examined. The rest of the main was put under air-pressure; and tests, by means of a water-gauge, showed that it was perfectly tight. He agreed that the explosion was caused by the accumulation of gas in the cellar of No. 26. The cellar being sealed up, and the ground floor of the house uninhabited, were specially favourable conditions to an explosion of gas. In his experience, it was usual for any company who had opened ground, and found a state of things that might endanger the gas-mains, to give notice to the Gas Company; and, the mains in this instance being so close together, it might reasonably be expected that what had caused damage to one main would cause damage to the other. A considerable escape of water, such as must have flown from the water-main, would wash away a large amount of the soil.

By Mr. RUBINSTEIN: In laying a main, if the soil was of a loose friable nature, it was usual to pack the main with timber to give it greater support. That was done in this instance, which showed the work was well carried out.

By Mr. LINCOLN REED: The fact that the service to Loveridge's kitchen had been there six years was sufficient proof that there was not a crack at the junction with the 4-inch main when it was put in. The main was an exceptionally thick one; and he thought it was an absurd suggestion of a previous witness that a slight fracture was made at the time the service was screwed in, and that it gradually enlarged. When opened, the ground had a honeycombed appearance.

Arthur Thirby, a foreman fitter in the employ of The Gaslight and Coke Company, deposed to having received information from Mr. Scourfield of a smell of gas at the office of the *Weekly Times and Echo* about 1.30 on the day before the explosion. He went immediately with a fitter; but they failed to trace any escape on those premises. They also examined the gullies and ventilators in the court, but could not detect the faintest smell of gas. He gave instructions for another examination to be made when the night pressure came on.

Charles Hartwell, the fitter who accompanied the previous witness, stated that, in accordance with his foreman's instructions, he visited the court at 6 o'clock in the evening, and again at 9.30; but could not discover any leakage. On the following evening, he made a further examination, and detected a smell of gas in the archway of the court; and at the time he was reporting the matter at the office, the information was received that the explosion had occurred.

Sir *Frederick Bramwell*, F.R.S., examined by the Hon. A. LYTTELTON, stated that he attended the investigations in the court on the 11th inst. He found in the asphalte, just above where the fracture proved to be, a very extensive and considerable depression, which could not possibly have existed at the time the surface of the court was formed. He had photographs taken of the depression from two points of view. He was told that the buildings had fallen to a very large extent over the surface of the court; and the depression seemed to him to be evidence that the ground underneath must have been very defective. When the fractured gas-main was laid bare, they found that, if measured a foot on either side of the fracture, the depression of the main in the middle would be about $\frac{3}{8}$ to $\frac{1}{2}$ inch. The effect of this was to materially open the crack on the underside of the main. His opinion was that a depression of a slighter character had taken place, through the subsidence of the ground, before the heavy weight of material had fallen upon the asphalte, because there was a crack in the pipe sufficient to allow the issue of gas to cause the explosion. A hole was dug down on one side of the main; and probing showed that the ground was quite unfit to afford ample support for the main. It was evident to him that the ground had been very much disturbed by the escaping water. He was quite prepared to say that the crack in the main was absolutely new; and that the main was of apparently good metal, and of very adequate thickness. The hole which had been made in the main to receive the service-pipe to Loveridge's restaurant was an ordinary and well-tapped one; and he could not discover any evidence of a crack having been made there at the time the connection was effected, as had been suggested.

Questioned by other Counsel, witness said he thought the extreme depression in the asphalte might have been about a foot. The condition of the soil would be quite consistent with the opening of the court for the purpose of carrying out sewerage works. He should think the water-main had broken from want of support, and the gas-main was fractured through the passage of water dealing prejudicially with the soil a short time before the explosion.

Three police constables who had been on duty in New Church Court during the preceding week at different hours declared that they had not noticed the smell of gas; and that, if they had done so, it would have been their duty to report the matter.

The CORONER then addressed the jury. He remarked that the inquiry had extended somewhat farther than was absolutely necessary to ascertain the cause of death, in order that as much light as possible should be thrown on the cause of the explosion. What the jury had to decide was whether the explosion was due to the culpable neglect of any person. If they were satisfied that the Gas and Water Companies, and everybody who had any dealings with them, had carried out their duties in a proper way, then there could not be, in that Court, any further question. He might point out that there had not been the slightest suggestion that anybody had been guilty of culpable negligence. It had been hinted during the evidence that the Water Company, in some way, had not done their duty; and the leakage of water had been the cause of the gas-main breaking. It was perfectly clear that the water-main did break, and was mended; but the Company certainly did no injury to the gas-main when repairing their own pipe. It was quite possible that the water-main broke through the settlement of the ground. A most serious attack had been made on The Gaslight and Coke Company, or their officials; and it was suggested, by the evidence, that it might be due to their neglect that the explosion took place. It was clearly, without any manner of doubt, a gas explosion; and, if it could be shown that the Company knew there was a dangerous leak, and neglected it, it would be a serious thing for them. If it could be shown that there was an official whose duty it was to look after the leak, and he neglected to do so, it would be a question whether there would not be criminal liability. Complaints were made generally in the court as to a smell of gas; but these did not come to the knowledge of the Gas Company. Only Scourfield made complaint to some of the Company's men; and it appeared to him (the Coroner) the Company did all they could. Their men, who were experienced, made several examinations of the court; and they gave their honest opinion that there was no escape. There was no cause for them to go into No. 26 unless invited. There were three parties interested; and he could not impute blame to any one of them.

The jury, after a short deliberation, returned a verdict of "Accidental death."

THE CHELTENHAM CORPORATION AND THE GAS-WORKS.

A Special Meeting of the Cheltenham Town Council was held on Monday last week, for the purpose of considering the propriety of promoting, in the ensuing session, a Bill to enable the Corporation to purchase, by compulsion or agreement, the undertaking of the Cheltenham Gas Company, and the Company to sell and transfer it to the governing body of the town; also for the purpose of considering the expediency of opposing a Bill intended to be promoted by the Company for obtaining further powers. The Mayor (Alderman Colonel Rogers) presided. Alderman Norman (the Chairman of the Lighting Committee) first submitted a resolution in favour of the promotion of a Bill to acquire the gas undertaking. The present share capital of the concern, he remarked, was £155,000, more than half of which (£80,000) was created in 1872. The dividends varied from 10 per cent. on the original stock to 7 per cent. on the newer stock. The loan capital was £17,500, which bore interest at 4 per cent. The Company had power to raise a further loan of £20,000, subject to the same interest. The amount required for dividends and interest was £12,550 a year. The profits in 1894, taken from the Company's balance-sheet, and including Directors' fees, amounted to £15,543; and this notwithstanding the fact that during the year there had been a lowering of the price of gas by 2d. per 1000 cubic feet. If the Corporation bought the undertaking, they would have to do so on the basis of so many years' purchase of the dividends now paid to the shareholders. The number of years was a varying quantity in such purchases; but Mr. Stevenson, who had been called in to advise the Town Clerk, had suggested 25 years as the probable basis. On that assumption, the purchasing price would be £313,000. This amount could be raised by the Corporation at 3 per cent. interest—probably lower—which would absorb (say) £9413 a year. In addition, a sinking fund would be needed, absorbing a further sum of £2761. Thus a total of £12,174 would have to be provided before any financial benefit would accrue from the purchase. As already stated, however, the profits last year were £15,543; and assuming that they would be kept up (the probability was that they would be increased), there would remain a margin of £3369, which would be available for town purposes; and this after £2761 had been invested out of the profits towards the redemption of the borrowed capital. Further, the Company possessed a reserve fund of £15,500, and stocks valued at £8000, which would come into the hands of the purchasers, and would raise the surplus profits to upwards of £4000 a year. The present market price of the gas shares was 22½ years' purchase. Therefore, on a 25 years' basis, the shareholders, who would receive £175 for every £100 of stock, would get an advantage of £17 over the present market value. Thus both the ratepayers and the shareholders would benefit by the transfer. Mr. Parsonage seconded the motion. Alderman Wethered expressed himself in opposition to the proposed purchase, but said he would not vote against the present proposition, because, by defeating it, the Corporation would deprive the ratepayers of the opportunity of saying whether or not they desired the gas-works purchased. The motion was carried by 16 votes to 1—the dissentient being Mr. Moses Davies. Alderman Wethered did not vote. Alderman Norman next proposed a resolution sanctioning opposition to the Company's Bill; and this was agreed to without discussion.

EXTENSION OF THE WOLVERHAMPTON GAS-WORKS.

The extensive alterations and additions to the works of the Wolverhampton Gas Company which the Engineer and Manager (Mr. John Annan) commenced in the spring of last year have now been completed, and the works are consequently in a condition to meet the increased demand which will doubtless be made upon them in the coming winter. The principal feature of the extensions is a new gas-holder, which has been put up to supplement the four now existing at Stafford Road. The contract for the tank for this holder was let to Mr. H. Holloway, of Wolverhampton, and he was the first to commence operations—the site selected being a meadow at the rear of the old works, and close to the main line of the London and North-Western Railway. The tank is of brick; the dimensions being 165 feet in diameter and 30 feet deep. This part of the work was completed by the close of 1894, and left ready for the Contractors for the holder (Messrs. C. & W. Walker, of Donnington), who were engaged in its erection until the middle of the present year. The holder is supported by 18 guide-columns 60 feet high; and it will afford an additional 1,200,000 cubic feet of storage—bringing up the supplying capacity of the works to 2,000,000 cubic feet per day. That this quantity may be needed may be inferred from the fact that the output of gas in the first week of the present month exceeded by more than 1,600,000 cubic

feet the make in the corresponding week of 1894. With regard to manufacturing plant, eight generator furnaces have been put up by Messrs. Jonas Drake and Sons, of Halifax. Other additions to the works are in contemplation. On a site comprising about three or four acres, recently acquired just outside the borough, it is proposed to put up another holder and erect a retort-house with the necessary auxiliary manufacturing plant. In course of time, a canal basin will be constructed for unloading the coal-barges; and an extra line of branch railway is to be laid down. These projects are occupying Mr. Annan's attention. The carrying out of the entire scheme will have for result the reduction of operations at the Horsley Fields branch of the works, which has always been cramped.

LARGE EXTENSIONS AT THE KEIGHLEY GAS-WORKS.

The past year has been busily occupied at the Keighley Gas-Works in making some important extensions; and the work which has been in hand is now practically completed. The additions are of such a character that the productive capacity of the works (which was previously put at a million cubic feet per day) has been doubled. A new retort-house has been erected at one end of the old retort-house; the dimensions being 160 feet by 90 feet, with a height from the floor to the springing of the roof of 26 feet. The house is fitted with ten beds of through retorts (with 180 mouthpieces), set on the regenerative principle. The house has been fully equipped with machinery. The railway coal-trucks, as required, are pushed along rails into the retort-house by an engine; and the coal is delivered at several positions on either side. At these points, coal-breaking machines are fixed on the ground floor; and, after the coal is broken, it is lifted by small buckets fastened to an endless chain to receiving hoppers. From these hoppers it is fed, as needed, into the stoking-machine—both the charging and drawing machines, made by the West's Gas Improvement Company, Limited, of Manchester, having been removed from the old house, which was found unsuitable for their use. After the coke has been drawn, by the machines in the new house and by the stokers in the older premises, its disposal is brought about by an ingenious mechanical arrangement, fitted up by Messrs. Newton, Chambers, and Co., of the Thorncliffe Iron-Works, Sheffield. Parallel with the lines of retorts, a travelling web of metal plates has been fixed in the basement, upon which the coke is dropped from an iron receptacle carried in front of the drawing-machine, and through shoots in the old house; and, in its passage, it is automatically cooled by water. At the north end of the old house, it is deposited by these plates into a bucket elevator, and placed in another metal channel running at right angles to the plates—this new channel conveying it to the side of the old building. Here another elevator is at work, together with a breaking-machine; and this elevator takes the coke on still another journey to the very top of the building, on to an additional structure which has been placed at the side. There, if the breaking-machine is not in operation, the coke is tumbled over a shaking screen to free it from dust, into a large receiving hopper, from whence carts and railway waggons can be easily filled. On the other hand, if the breaking-machine is working, the burden of the elevator is conducted into a graduated screen which separates the coke into the three usual sizes of blacksmith's coke, household coke, and large coke, each being distributed into its separate storage hopper; the dust again finding its way into the receptacle already mentioned. Concurrently with the increase in the productive capacity of the retort-houses, other extensions and re-arrangements have been necessary in the plant. The condensers have been made equal to the greater demand upon them; and it has been considered advisable to put down a new engine and exhauster, capable of dealing with 70,000 cubic feet of gas per hour. This machinery has been made by Messrs. G. Waller and Co., and fixed in an extension of the old exhauster-house. A new washer has also been put down. Before the work of extension can be said to be thoroughly complete, it will be necessary to increase the number of purifying beds and the storage accommodation. Among the new works which have been erected are a store-shed and a mechanics' shop; and a new meter has been fixed. The cost of the improvements carried out up to the present is above £20,000. The whole of the new works have been constructed to the designs of the Gas Engineer (Mr. J. Laycock); and among the contractors were: Messrs. Clayton, Son, and Co., Messrs. Clapham Bros., Messrs. Newton, Chambers, and Co., Messrs. Drake and Son, and Messrs. J. & J. Braddock.

It will be interesting here to refer briefly to the great advance that has been made in the demand for gas, which necessitates these large extensions. The Keighley Local Board was one of the first public bodies in the country to establish gas-works; the old plant at Low Bridge having been put down in 1825. These works met the needs of the town for many years. But in 1876 the present works at Thwaites were opened; and the additions above described are the first real extension which has been made of them. The greatest day's consumption in 1876 was 463,000 cubic feet; in 1882 (when the town was incorporated), it had grown to 681,000 cubic feet; and last winter the maximum day's make was 1,165,000 cubic feet—a figure which, it is expected, will be raised to 1,400,000 cubic feet during December and January. In 1876, the number of consumers was 4486; in 1882, 6324; and last June, 10,259. In those years, the total quantity of gas made was respectively 76,216,000, 116,298,000, and 226,400,000 cubic feet.

Continental Union Gas Company, Limited.—The Directors of this Company have decided to recommend dividends of 8 per cent. for the past half year on the ordinary, and 6½ per cent. on the preference stocks—the same rates as last year—both free of income-tax.

Holyhead Flooded and in Darkness.—Owing to a continuous heavy fall of rain on the 16th inst., several parts of Holyhead became completely inundated. The torrent of rain burst into the gas-works, and put out the fires. The street-lamps were unlit in the evening; and in many houses paraffin oil and candles had to be resorted to.

THE SALE OF THE SOUTH MOLTON GAS-WORKS.

A Meeting of the shareholders in the South Molton Gas Company was held last Wednesday, to consider the agreement provisionally made for the sale of the works to the Town Council for the sum of £3300, the par value of the shares. Mr. J. E. Eldridge, the Chairman of the Company, presided. Mr. W. Oram, the lessee of the works, said that he thought the Directors had acted hastily, and that, before any agreement was entered into, they should have consulted the outside shareholders. The Secretary (Mr. T. Chapple) said the lessee's term expired in June next; and if the Town Council had not been able to advertise now that they intended to apply for a Provisional Order, the matter must have stood over for twelve months; and from June the shareholders would have had to carry on the works themselves. Despatch was therefore necessary. Mr. J. Sanders moved that the provisional agreement be confirmed. Personally, he did not care whether the sale was carried out or not, but he wished to benefit his native town; and if the matter fell through, it would be a lesson to those who did not appreciate the manner in which the Directors had met the Town Council. The motion having been seconded, Mr. Young moved an amendment to the effect that the works be valued and offered to the Corporation at the valuation price. He strongly objected to the manner in which the outside shareholders had been treated. His interest in the Company was only a small one, for he held six shares, for which he would get £90. But he had been receiving £5 8s. per annum interest; and where could he obtain this return on his money? He firmly believed the purchase price was too low; and a practical man had told him they were throwing away at least a thousand pounds. On a vote being taken, four shareholders were for the amendment, and thirteen for the motion, which was therefore carried. The Directors were authorized to take all necessary steps to carry the agreement to completion.

ELECTRIC LIGHTING REGULATIONS.

Conference on the Proposed Revision of the Rules.

A Conference of Corporations and Companies concerned in the regulations made by the Board of Trade under the Electric Lighting Acts of 1882 and 1888 was opened last Tuesday in the Town Hall, Westminster, to consider proposals for revising the regulations in question. A draft of the proposed revised regulations had been sent to the parties interested, and their observations upon them had been invited. Sir COURTENAY BOYLE, K.C.B., of the Board of Trade, presided; and he was accompanied by Sir T. Blomfield, Bart., Mr. Hopwood, C.M.G., and Major Cardew, R.E., of the Board of Trade, and by Mr. W. H. Preece, C.B., Electrician to the Post Office.

In opening the inquiry, Sir Courtenay Boyle stated that the Board of Trade, finding it necessary to revise the regulations made by them under the provisions of the Electric Lighting Acts of 1882 and 1888, had thought it convenient as well as courteous to give to all who had raised objections an opportunity of stating them verbally; thereby assuring that the Board of Trade's final decision might not be come to until after carefully hearing all that could be said on the various matters dealt with in the regulations. Though the entire responsibility rested on the Board of Trade, who could not divest themselves of their statutory obligations, he assured those present that the Board would carefully weigh all the arguments and representations that might be placed before them. The regulations would apply to undertakers only, and not to works put up by consumers. The Board hoped to make them retrospective; but this point could not be decided at present.

The conference then proceeded to consider the proposed revised regulations in detail. The first controversy arose on a definition of the word "pressure." It was argued on behalf of the British Insulated Wire Company that the old regulation, prohibiting working at above 150 volts pressure, had not answered well. Mr. Hammond said it was well known that great improvements had been made in the distribution of electricity, and that reliable electric lamps had been introduced working at from 200 to 250 volts. It was most desirable that this improvement should be facilitated. They hoped in time they would be allowed to go up to 600 volts. The instances of persons being killed at a pressure of 600 volts were very few. In his own case, it only slightly burned his hand. Mr. Siemens was satisfied that the proposed new regulation would be sufficient to secure the safety of the public. There could be no limit that would be absolutely safe, because the effects of the electric shocks depended so much on the condition of the individual. He had known the case of a workman who had survived a shock of 2000 volts. Dr. Hopkinson pointed out that in Manchester a pressure of 400 volts was occasionally required. Sir C. Boyle, though not pressing the point home, remarked that Manchester had been infringing the regulations. Dr. Hopkinson replied that, whether they had done so or not, their experience was such as to justify the Board of Trade in sanctioning a pressure not merely up to 300, but up to 500 volts. Earl Russell, for the London County Council, suggested the propriety of making provision for an intermediate class of pressure without jumping so abruptly from low to high. Mr. Morse supported the suggestion that the voltage should be raised to 500. Major Cardew gave his view of the safety of the public. It was impossible, he said, to lay down precisely the limit where the electric current became fatal—a great deal depending on the person who received it, and particularly the condition of his skin. He thought the low pressure for alternating current might be slightly raised. As regarded the continuous current, 200 or 250 volts might be used in houses with the consent of the consumers. Sir C. Boyle had no hesitation in saying that it was his intention to advise the Board of Trade to raise the 150 volts to a higher figure—220 or some other. In regard to the 300 volts, he thought this too might be slightly raised. All they were insisting upon was that there should be additional precautions in regard to high-pressure systems. As to the regulation that no high pressure electric line shall be used for the transmission of more than 200,000 watts except with the consent of the

Board of Trade, Sir C. Boyle promised to consider whether he could not go as far as 500,000 watts.

A good deal of discussion followed on the proposed regulation dealing with faults of insulation. Sir C. Boyle said that, under the existing regulations, it was quite impossible to maintain the insulation required; but he promised to keep the exact wording of the new clause open, so far as regarded the time and nature of the tests to be applied. On the representation of the London County Council, Sir C. Boyle said he would consider whether in London aërial lines over thoroughfares should be 20 feet instead of 18 feet from the ground.

An important discussion arose upon the following proposed regulation: "All conduits, pipes, or casings used as receptacles for electric lines shall be constructed of durable material, and of ample strength to prevent damage from heavy traffic, and, where they are laid in streets in which gas-mains are also laid, shall be so constructed as to prevent any influx of gas from the adjacent soil." Representations from all parts of the country were made in regard to the clause. The Dublin Corporation declared that, if they had to prevent "access of gas," they would have to reconstruct all their boxes; and they doubted if the result would be more efficient. The Dover Electricity Company and the County of London Company suggested the addition of the words "so far as possible," after the words "so constructed as to prevent." The Yorkshire House-to-House Company submitted that the use of a blower for keeping mains free from gas and water should be considered sufficient, without requiring the prevention of influx by a special construction of conduits and boxes. The Islington Vestry were of opinion that the regulation would seriously increase the responsibility of undertakers, and put a powerful weapon of defence in the hands of gas companies. The London Chamber of Commerce believed that a clause providing that all conduits constructed in streets in which gas-mains were also laid should be efficiently protected against an accumulation of gas would meet the requirements of the case. The Glasgow Corporation declared it was impossible so to construct culverts as to prevent an influx of gas; and they suggested that the words "all reasonable precautions shall be taken" should be substituted for that part of the regulation. The Charing Cross and Strand Electricity Supply Company wrote that the clause appeared to be impossible as regarded the prevention of an influx of gas. Ventilation was the only practicable remedy. The Portsmouth Corporation and the Vestry of Shoreditch both strongly emphasized their disagreement with the terms of the clause. It would be quite impracticable, they said, to attempt to render conduits gas-tight. The gas companies should keep their mains gas-tight, and the electric light undertakers should be required to ventilate their conduits. Gas companies would make this regulation a point of defence for any damage that might accrue through gas leaking into conduits. The Westminster Electrical Supply Company, supported by the Corporations of Edinburgh, Aberdeen, Belfast, Oldham, and Sunderland, represented to the Board of Trade that, as gas companies were unable to prevent leakages of gas from their pipes, it was unreasonable to ask electrical undertakers to devise some way of keeping the gas out of their pipes and conduits, and that the only real remedy lay with the gas companies. They suggested that the electric light companies should take every reasonable means to prevent gas entering their pipes or casings; that the companies should subject these to periodical inspections (which might be specified); and that it should be their duty to report at once to the gas company any case in which gas was found to exist, and at the same time either report to the Board of Trade or to the Sheriff or Local Authority if the gas leakage were not found and remedied by the gas company within a reasonable time. A regulation such as this could be enforced and carried out, whereas the proposed regulations could not be carried out; and their existence as a dead letter might stand in the way of any reasonable steps being taken. The Institution of Electrical Engineers sent in the following in substitution of the regulation proposed by the Board of Trade: "All conduits, pipes, street-boxes, or casings, used as receptacles for electric lines shall be constructed of durable material, and, wherever they are laid under carriage-ways, shall be of ample strength to prevent damage from heavy traffic; and reasonable means shall be taken by the undertakers to prevent accumulation of gas. The undertakers shall regularly inspect their street-boxes for the presence of gas; and should any influx or accumulation be discovered, the undertakers are to give immediate notice to the gas authority." The Institution contended that undertakers should only be required to take precautions against the accumulation of gas. The risk from explosions caused by influx of gas was very small, save under exceptional circumstances, such as the frost of last winter. When many gas-mains were broken, it was impossible to prevent influx of gas to chambers underground. They were of opinion that there should be a stricter enforcement of the Gas Acts.

In the course of the discussion on this point,

A delegate from Islington suggested that, in this matter, the onus should rest on the proper authorities. He knew that it had been stated to the Islington Vestry that they had no power over the gas companies; but what he wanted to urge was that they should have some power. He contended that the proposed new regulations—read in connection with some of the other regulations—would put a very powerful weapon into the hands of the gas companies. In the well-known case of the St. Pancras explosion, the Engineers of The Gaslight and Coke Company said that it was the duty of the electric lighting companies to keep gas out of their mains. If this contention were allowed, and such a weapon were placed in the hands of gas companies, it was obvious that the electric lighting proprietors would have to pay for the delinquencies of the gas people. On behalf of his Vestry, he wished to urge that electric lighting undertakings ought not to be hampered by reason of the faults of large corporations and other bodies. He hoped, therefore, that the Board of Trade would carefully consider the matter before allowing the proposed regulation to stand.

Mr. GAY, of the Islington Vestry, dwelt on the impossibility of giving effect to the clause as proposed, which put an onerous duty upon undertakers with which they ought not to be burdened, and which gave a great advantage to the gas companies.

Mr. R. HAMMOND, on the grounds put forward by Mr. Gay, supported the recommendations of the Dublin Corporation and the Yorkshire House-to-House Company. He had always felt it better to provide boxes without any bottoms—that they should be open to the soil, so that all the land drainage could easily get away. They had no difficulty, in Dublin or Leeds, in getting rid of the water. The word he objected to principally in the draft regulation was "influx;" and upon this point he would certainly support the proposal made by the Institution of Electrical Engineers. He did not think they should be called upon to prevent the influx of gas. He admitted that they should prevent its accumulation; and he had recently, in one or two cases, filled up the boxes with sand, so as to prevent an absolute accumulation of gas, and in other cases with wood blocks. But he repeated that he did not think they should be called upon to take the responsibility of preventing influx of gas from the adjacent soil.

The representatives of Swansea and Shoreditch intimated that they were prepared to support the clause brought forward by the Institution of Electrical Engineers in lieu of that of the Board of Trade.

Sir J. RUSSELL (Edinburgh) said he would like to mention the only two accidents they had had in his city in connection with electrical conduits, just to show the necessity of impressing gas companies with the great importance of keeping their gas in hand. These two accidents occurred through the accumulation of gas; and it was supposed that someone had dropped a match in the street, and so caused the ignition of the gas.

Sir C. BOYLE: We sent out a circular to the several companies, calling attention to that very point.

Sir J. RUSSELL: I only mentioned the matter to show the difficulty of preventing gas that leaks in the streets making its way into manholes, boxes, and so forth. We can only try to get rid of it by proper ventilation.

The representative of the Westminster Supply Corporation said that the amended clause suggested by the Institution of Electrical Engineers was the result of a good deal of thought and experience. Last year his Company had no explosions in connection with their system; and they had escaped these by giving timely notice to the gas companies in every case where accumulations were suspected or detected. The true remedy, he believed, was the necessity of due notice being given to the companies, at the very earliest possible moment, of any leakage discovered. In the cases with which he had been concerned, the gas companies had always accepted the responsibility, and stopped the leakage at the first opportunity; and he attributed their immunity from explosions to the good feeling the gas company had shown, and to the way in which they had worked with the electric company. The proposals brought forward by his Company [quoted above] would, he believed, be approved by the gas companies.

The representative of the London Chamber of Commerce mentioned his intention to support the clause suggested by the Institution of Electrical Engineers. It appeared to him to be very hard that the gas companies should be protected by regulations put into the Electric Lighting Acts; thus involving undue responsibility on the part of the electrical undertakers.

Another delegate pointed out that these explosions were not confined to electric lighting conduits. They had occurred in pipes carrying telephone wires, and also in empty pipes.

Mr. GAY remarked that he could also submit proof of explosions other than those caused by the conditions of electric light wires.

Mr. GUNYON, for the London County Council, said the importance of this point could not be overrated. The proposed regulations specified that the conduits were to be so constructed as to prevent the influx of gas. The electric supply companies were agreed in saying that this was impossible; and he believed that, at all events in a city like London, it was so. The electric companies, however, suggested the insertion of the words "as far as possible." It appeared to him that the use of such a saving clause would encourage the companies not to make any effort in the matter. It might be possible in many cases to prevent the influx of gas by filling up the conduits and boxes; and he should think that, in their present state of knowledge, this was the best way. But it must be remembered that in many cases the gas companies, and also the gas-mains, were in possession of the ground; and any company coming fresh into the ground were under an obligation to see that their doing so was not dangerous to the public safety.

Another delegate, speaking on behalf of several companies and municipalities, assured the Board of Trade that there was no need of outside pressure to induce them to take every possible care; and, as a matter of fact, the companies who had not had any explosions were known to be those who were the most careful.

Mr. R. H. DAWE, the Town Clerk of Hull, as representing some of those corporations who possessed electric lighting installations, wished to remind Sir Courtenay Boyle that they represented the public as much as the London County Council; and he dissented from the proposition that had been laid down by that body. It appeared to him to be unreasonable that any regulation should impose on the proprietors of electric lighting installations the responsibility of excluding gas. If gas were not present in the soil, it would be impossible that explosions could occur. It was reasonable to ask electric lighting people to take all necessary care, but not more than that.

Mr. W. H. PREECE, C.B., said he should like to remark that, from 44 years' experience of the fight between gas and the pipes, the Post Office had succeeded in getting what they wanted. In London alone there were 8000 boxes, and in the United Kingdom 16,000 boxes, in connection with the Post Office electrical services. It was a very rare thing that a year passed without several explosions taking place. Not much was heard of them. He did not say that the gentlemen of the Press were bribed; but where accidents were frequent, people became callous, and the information did not get into the papers. He should like to point out, in reference to what Mr. Hammond had said, when he advocated the leaving of the bottoms of the boxes open, that this was what the Post Office did not do, and were prevented from doing. They were obliged to fill them up. They had done everything that reasonable beings could do to prevent the influx of gas into the boxes. But it did get in nevertheless; and, owing to people throwing down matches, or from sparks arising from other sources, there would be explosions where there was an accumulation of gas. It was difficult to prevent it. He was in favour of the proposal put forward by the Institution of Electrical Engineers. He admitted that there was a

difference between electric lighting interests and those of the Post Office, owing to the difference in the size of the boxes. There was a little difficulty in keeping gas out of the Post Office boxes, but more in excluding it from the larger boxes used by the electric lighting companies.

Sir C. Boyle said he should like to see the gas companies obliged to keep their gas in their own pipes, and the electric companies obliged to keep the gas out. He knew, however, that it was difficult, if not absolutely impossible, to enforce this obligation in either case. Therefore the clause as it stood on the paper must fall to the ground; and he would propose to the Board of Trade a clause based on the recommendation of the Institution of Electrical Engineers.

Mr. Crompton expressed his gratitude to Sir C. Boyle for the concession he had made.

The conference then adjourned.

On the resumption of the proceedings the following day,

Sir C. Boyle stated that he had carefully considered the very important representations made at the previous sitting on the subject of the definition of low pressure. The point raised was highly technical and scientific; and he thought it would be for the convenience of those interested if a decision was reserved for a short time, so that the Board of Trade might appoint a small Committee (not exceeding three) of expert advisers, to carefully consider the scientific aspect of the question, and make a suggestion to the Department.

General Webber, with whom originated the suggestion made the previous day, said that electrical engineers would most heartily agree in the wisdom of the proposal of the Board of Trade.

Approval having also been expressed by Mr. Crompton and Mr. Hill Dawe, on behalf of municipal corporations,

Sir C. Boyle said he would recommend to the Board the appointment of a Committee.

The conference then proceeded to the discussion of the remaining proposed regulations. Clause 31 was amended so that the inspection of insulators should be made prospective.

On the regulation that "all street-boxes which contain any vacant space shall be so constructed as to prevent any influx of gas or water, either from the adjacent soil or by means of any pipes; and ample provision shall be made, by ventilation or otherwise, for the immediate escape of any gas which may by accident have obtained access to the box, and for the prevention of danger from sparking,"

Sir C. Boyle said he had been forced to the conclusion that it was absolutely necessary to ventilate transformer chambers; but he was not clear as to how far it was necessary to ventilate all street-boxes.

After a good deal of discussion,

Sir C. Boyle suggested that the proposed regulation should apply only to street-boxes containing transformers. The clause would read thus: "In the construction of street-boxes used as transformer chambers, reasonable means shall be adopted to prevent, as far as possible, any influx or accumulation of gas or water, either from the adjacent soil or by means of pipes; and ample provision shall be made, by ventilation or otherwise, for the immediate escape of gas which may by accident have obtained access to the box, and for the prevention of danger from sparking." He would consider whether the Board of Trade could make a regulation for the ventilation of street-boxes of certain dimensions.

On the regulations dealing with the power given to undertakers to cut off the supply when the insulation resistance does not exceed 75 megohms, divided by the number of lamps fixed,

Professor Kennedy said he considered that the regulation ought to provide that undertakers should not connect up any consumer where the insulation resistance was less than 75 megohms divided by the number of points for taking off current; and it should disconnect consumers whose insulation resistance fell below that standard.

Sir C. Boyle promised to frame a regulation upon the basis suggested by Professor Kennedy; reserving the particular standard to be fixed.

A discussion arose as to what was considered, especially by the Town Clerk of Hull, would be the unfair operation of the following proposed regulation as between electric undertakers and gas companies: "If the undertakers make default in complying with any of the preceding regulations, they shall be liable to a penalty not exceeding £10 for every such default, and to a daily penalty not exceeding £10. The imposition of any penalty under this regulation shall not affect the liability of the undertakers to make compensation in respect of any damage or injury which may be caused by reason of such default."

Mr. Dawe said this was a very important clause, and, as it stood, it might result in throwing upon electric lighting undertakers a responsibility which primarily belonged to another company or body. He did not think the Board of Trade, in framing these regulations for the public advantage, intended to confer an advantage on gas companies at the expense of electric lighting undertakers. The electric undertakers were anxious to carry out the regulations as they stood; but they were dependent upon human agency, and therefore were liable to miscarriages. Assuming that, notwithstanding the regulations, an accident did occur, what would happen? The person who had suffered injury would go to the electric supply undertakers and say: "You have not observed the Board of Trade regulations; you have committed an illegal act. I do not care who is primarily responsible; I will take proceedings against you." The undertakers were quite agreeable to be subject to a penalty in case of non-observance of the regulations; and they were also quite willing to run the risk, whatever it might be, of their common law liability. What they did object to was that the public, for whose protection the regulations were drawn up, might use them in order to shift responsibility from the shoulders of the company primarily responsible, and put it on the shoulders of the electric undertakers, who might only be in a secondary degree liable for the accident. In the case of an escape of gas, very stringent regulations were placed upon the undertakers in regard to it; and those regulations they were willing to observe to the utmost of their power. But they suggested that, if an accident did occur, and some person was injured, that person ought to rely upon the common law remedy, and proceed against the company who was primarily responsible, whether they were a gas company or any other body. He thought that words to this effect might be added at the end of the regulation: "And that nothing in this regulation shall impose upon the undertakers any liability to make any compensation in respect of any damage or injury which may be caused by reason of such default." They ought to make sure that the regulation could not be used by one of the public as an engine to place upon the electric undertakers what he might call an unlimited liability and responsibility. But for this regulation, they would, no doubt, be frequently able to successfully combat claims that might be brought against them.

Sir C. Boyle said he did not himself see where the responsibility was shifted; and his Counsel advised him that there was no shifting of responsibility which now lay on any gas company or other body.

Mr. Dawe argued that, by the regulation, if there was a breach of the other regulations, there was the commission of an illegal act; and action would be taken against the electric undertaker quite regardless of the circumstances or of the precise factor which was the cause of the accident, and which they would assume was an escape of gas. What they wanted to obtain was some protection against proceedings of this kind. The clause itself gave protection in respect to the penalty. They wanted similar protection in regard to the matter to which he had called attention. It was quite unreasonable to place an unlimited responsibility upon electric undertakers for a breach of one of the regulations.

Sir C. Boyle said he was advised by his Counsel that the word "affect" in the regulation meant "affect" either way. The regulation did not propose anything new, or remove anything from any party; and it was not very wise to begin experimenting with what was an established meaning attached to the phrase.

Mr. Dawe said he had considered this view of the interpretation of the clause; but he feared it would not be established in Court.

Sir C. Boyle: Would you like these words—"nothing in this regulation shall alter the liability"?

Mr. Dawe: Precisely.

Sir C. Boyle, after consulting with his Counsel, said this gentleman had a little difficulty as to the precise wording of the regulation; but he (Sir C. Boyle) would deal with it the best way he could.

At the close of the conference,

Sir C. Boyle, on behalf of the Board of Trade, thanked the delegates for the assistance they had given him.

In return, the delegates passed a cordial vote of thanks to Sir Courtenay Boyle for the consideration and courtesy with which he had treated their representations.

ELECTRIC LIGHTING NOTES.

The electric lighting question has again come up at Folkestone. At a special meeting of the Town Council last Thursday, the following notices were upon the *agenda*: "(1) To consider the expediency of applying to the Board of Trade for a Provisional Order to be granted to the Corporation and Urban District Council of Folkestone to light the whole or any part of their district with the electric light, and as to site of generating station; plans, estimates, and details to be prepared and steps to be taken. In the event of the Corporation not passing such resolution to apply for a Provisional Order, (2) To consider an application on the part of Mr. Daniel Baker for the Corporation to assent to, and support, an application for a Provisional Order, in the above form, on the part of himself for his nominees. (3) To consider notice from the Capital and Counties Electricity Supply Company, Limited, of their intention to apply, on or before the 21st of December next, to the Board of Trade for a Provisional Order to authorize the Company to supply electricity for public and private purposes within the Borough of Folkestone." The Town Clerk (Mr. W. G. S. Harrison) read a letter he had received from Messrs. W. G. F. Webster and Co., in which reference was made to the offer of Mr. Webster to light the Leas at a certain specified cost, and stating that, if the Corporation decided to go on with the matter, they would undertake to get the installation completed next year. Mr. Baker moved the formal resolution prepared by the Town Clerk. He remarked that they were face to face with an alternative. They must either get a Provisional Order to light Folkestone themselves or allow someone else to do it. In his opinion, they should do it themselves. There were two other notices on the paper—one from himself and the other from a Company; and they heard there was another application from Mr. Webster. No doubt they would get any number of others who would be only too pleased to step into the gap. If they obtained a Provisional Order, and thought fit to sell it, they could make £500 or £1000 out of it. It was imperative that they should have electric light at the west-end of the town; and unless the Corporation were prepared to supply it, he must do it himself. Mr. Hall seconded the motion. He confessed that he thought the step proposed was in the right direction, and the only one they should take. They had had various schemes before them—one to cost £75,000, another £35,000, and another £12,000; and there was a general feeling that the Corporation would be very unwise to speculate with the ratepayers' money to such an extent. But, as Mr. Baker had said, unless they applied for a Provisional Order, they would find other people stepping in and doing so. After some conversation, the motion was carried unanimously.

The electric light works of the Coventry Corporation have been completed; and the consumers are now being served with current. The works are very conveniently situated; being on the canal bank, with a railway siding from the Nuneaton branch of the London and North-Western Railway. The dimensions of the main block of buildings are 115 feet by 80 feet; the cost of erection being £6859. The plant and machinery were supplied by Messrs. J. Fowler and Co.; their tender being £9672. The total cost of the works was estimated at £20,000; and the actual outlay approaches very closely this amount. Intending consumers will be connected with the mains free of cost until the end of the year. About a fortnight ago 1400 lights of 8-candle power had been applied for; but only 600 were then connected.

The little Cornish town of Saltash is to have its streets lighted by electricity. Last Tuesday, the Town Council received tenders for public lighting for the year commencing January next. Among them was one from Mr. T. Martin, offering to supply the electric light at £2 10s. per lamp. This was accepted, subject to a guarantee for the performance of the work to the satisfaction of the Corporation. The streets are at present lighted by gas.

The Kettering District Council, by six votes to eight, agreed last Wednesday to make application for a Provisional Order to empower them to undertake electric lighting. The Chairman of the Council (Mr. Stockburn) and another member (Mr. H. W. Church) did not vote on the ground that they were shareholders in the Gas Company, and therefore did not think it would be consistent to do so. Had they voted, there would have been an equal division of members for and against the proposed application.

An instance of the instability of the electric light occurred at Wolverhampton on Monday last week, when, about half-past four in the afternoon, it suddenly went out, leaving the shopkeepers and the town itself in darkness. The Town Council were holding a special meeting at the time; and the Mayor (Alderman Mander) was in the midst of a speech when the Council Chamber was plunged in darkness. The gas was promptly turned on; and the debate proceeded. After a short interval, the electric light was restored. The cause of the failure was a mishap to one of the transformers.

FIRE RISKS INCIDENTAL TO THE LIGHTING OF PAPER-MILLS.

In the course of an article on the above subject, by Mr. Ludovic M'Lellan Mann, of the North British and Mercantile Insurance Company, Glasgow, in the *Paper Makers' Circular*, reference is made to the risks attending the employment of gas and electricity as illuminants in paper-mills. The author indicates briefly the precautionary measures to be taken to minimize the dangers arising from gas. He says careful attention should be given to gas-brackets in the machine-room, as they are apt to become loose at the joints, and therefore dangerous. While the newly-formed web is being guided, it, or pieces torn from it, may come near, or into contact with, the gas-lights fixed in close proximity to the machinery. It is therefore expedient to guard these lights by strong wire globes. It, indeed, should be a rule that gas-lights at the dry end of the machine-room, in drying-lofts, and near paper-cutters should be so protected. Where rags are sorted, cut, or dusted, or where esparto is dusted or "dry-picked," lanterns should invariably enclose all gas-lights. In planning the construction of esparto and rag-dusting and storing houses, it would be desirable to arrange to have the source of artificial light—whether oil, gas, or electric lamps—outside, and accessible from the outside only. This system of illuminating from the outside could even be applied to existing buildings in many instances. With regard to lighting by electricity, Mr. Mann says there are dangers in connection with the lamps which call for safeguards not less evident than those just mentioned. For example, the surface round the top of the bulb of an incandescent electric lamp in the dry department is apt to become thickly coated with fluff and dust. Such a deposit upon the heated surface of the glass is dangerous, and should be prevented from forming by placing the lamp in an outer glass globe arranged to exclude dust. Arc lamps are not safe in the vicinity of inflammable matter; and, in order to decrease the risk of the emission of particles of incandescent carbon and the dropping of melted copper, they should be enclosed at the base. Wiring and fittings are liable to injury by the incessant vibration going on; necessitating frequent repairs. Many owners of mills consequently become dissatisfied with the electric light; and some have reverted to gas lighting. The gist of the whole question of safe wiring is really good workmanship. It is more costly in the long run to accept a low-priced estimate for the wiring of premises exposed to deteriorating influences. But given a sound installation, and a competent engineer in charge of the electric lighting machinery, who is always ready to replace broken lamps and do repairs, Mr. Mann thinks the electric fire hazard may be reduced to a minimum.

Incandescent Gas Lighting for Public Thoroughfares.—The Incandescent Gas-Light Company, Limited, have received an order from the Kensington Vestry for a large additional number of burners for street lighting; it being their intention to considerably extend the use of this system for the public thoroughfares. They have also had instructions from the Chiswick Urban District Council to light a large portion of their district; and they are in negotiation with most of the lighting authorities in London and the suburbs. At the meeting of the Commissioners of Sewers of the City of London last Tuesday, Mr. C. T. Harris moved that it should be referred to the Streets Committee to make experiments with incandescent gas-burners concurrently with the proposed experiments in incandescent electric lighting; and he suggested that the trial should be commenced in Wood Street, where not more than eight or ten lamps would be required for the purpose. This was agreed to. A trial, on a small scale, of incandescent gas-burners is to be made in the streets of Guildford. The Lighting Committee of the Town Council reported last Tuesday that the Gas Company were willing to supply incandescent burners in place of the ordinary ones, and to maintain them in good order for twelve months, for an additional payment of 13s. per lamp per annum. According to a letter read by the Mayor (Mr. R. Salsbury), which he had received from the Manager of the Company, the total cost of supplying and renewing the lamps would be £3 13s. 6d. The Committee were empowered to order a number of incandescent lights to replace the ordinary lamps in various parts of the borough; and, after having experience of the system, they are to report further on the subject. The authorities of Rye, Sussex, have decided to adopt a system of incandescent gas lighting for the public thoroughfares; the Gas Company having offered to undertake the work of carrying out the scheme.

METROPOLIS WATER SUPPLY.

Projected Important Extension Schemes.

Last Tuesday, the parliamentary notices appeared for two Bills to be promoted next session to authorize the carrying out of important projects in connection with the water supply of the Metropolis. One is to give power to a Joint Committee of representatives of the West Middlesex, Grand Junction, and New River Companies to proceed with the scheme of reservoirs at Staines which came so prominently before Lord Balfour's Commission; and the other, to enable the New River Company to make considerable additions to their works. The Southwark and Vauxhall Company have also given notice of their intention to apply for power to carry out important works. We indicate below the principal features of these schemes.

The Bill in reference to the Staines scheme is, as mentioned above, to sanction the constitution of a Joint Committee of representatives of the West Middlesex, Grand Junction, and New River Companies, whose powers are to be defined, and their remuneration fixed. Broadly speaking, the "undertakers," as they are called in the notice, are to "make and maintain reservoirs in the parishes of Stanwell and Hampton, in Middlesex; a pumping-station in the parish of Stanwell; aqueducts, conduits, and lines of pipes in the counties of Bucks, Middlesex, and Surrey; an intake from the River Thames in the parish of Wyrardisbury, in Bucks, above the Bell Weir; make diversions of roads in the parishes of Stanwell, Littleton, and Sunbury, in Middlesex; make alterations of levels of roads in the parishes of Wyrardisbury (Bucks), Staines, Laleham, Ashford, Sunbury, and Hanworth (Middlesex); make diversions and alterations of lines and levels of roads and streets; remove sewers, steps, &c.; take and distribute waters of the River Thames, Colne River, Wraysbury River, Colne Brook, and the Mill Stream and Mill Head of the Hythe End Mills; together with the incidental works." Lands and buildings are to be acquired compulsorily. Power is to be given to the West Middlesex, Grand Junction, and Chelsea Water Companies to convey water to the mains and pipes of the New River Company; and arrangements will be made for agreements being entered into between the Companies. There are to be special provisions as to the raising of money, and as to guarantees, &c., by the undertakers; and the maintenance and management expenses are to be apportioned between the Companies they represent. A standing Arbitrator is to be appointed to determine any differences that may arise between the Companies or their representatives on the Committee. Authority will be sought to sell water to other water companies, sanitary authorities, &c. A large number of Acts of Parliament will necessarily have to be altered and amended to enable the scheme to be carried out.

The works specified in the notice are as follows: Two reservoirs (Nos. 1 and 1A) to be situated wholly in the parish of Stanwell; a reservoir (No. 2) in the parish of Hampton; a pumping-station in the parish of Stanwell; an aqueduct or conduit commencing in the parish of Wyrardisbury, in Bucks, by an intake from the north side of the River Thames, about 250 yards westward of the Bell Weir, and terminating in the parish of Hampton, at the south-west corner of the proposed reservoir No. 2—passing in its course through Wyrardisbury, Staines, Stanwell, Ashford, Laleham, Littleton, Sunbury, and Hanworth; an aqueduct, conduit, and line of pipes (No. 2) wholly in the parish of Stanwell, with a short line of pipes (No. 2A) to connect this aqueduct with the reservoir No. 1A; an aqueduct or line or lines of pipes (No. 3) wholly in the parish of Stanwell, with a short pipe-line (No. 3A) to connect it with the reservoir No. 1A; an aqueduct or line of pipes (No. 4) in the parish of Hampton, commencing at the intended reservoir No. 2, and terminating in the pumping-well at the West Middlesex Water Company's works at Hampton; an aqueduct or line of pipes (No. 5) also in Hampton, commencing at reservoir No. 2, and terminating in the property of the Grand Junction Water Company; an aqueduct or line or lines of pipes (No. 6) commencing in Hampton, passing through Sunbury, and terminating at West Molesey, in the subsiding reservoir on the works of the Chelsea Water Company; an aqueduct, conduit, or line of pipes (No. 7) wholly in the parish of Wyrardisbury, commencing in the Colne Brook, and terminating by a junction with the intended aqueduct No. 1; an aqueduct or conduit (No. 8) wholly in the parish of Staines, commencing by a junction with the Wyrardisbury River, and terminating by a junction with the aqueduct No. 1. These works will necessarily involve considerable alterations of levels and diversions of roads, all of which are fully set out in the notice; and the lands (common or otherwise) and buildings proposed to be taken are indicated.

The undertakers are to be empowered, by means of the proposed works, or some of them, to collect, divert, impound, and distribute the waters of the Thames, Colne, and Wraysbury Rivers, the Colne Brook, and the Mill Stream and Mill Head of Hythe End Mills, and their respective tributaries, and of any other streams and waters shown on the plans to be deposited, and of any streams and springs on and near the intended works. But the Bill will provide that the undertakers shall not, by means of the intake by which the aqueduct or conduit No. 1 is intended to commence, "take the waters of the River Thames so as thereby to reduce the flow of water over Bell Weir to a less quantity in any one day of 24 hours than Parliament shall think right to prescribe in that behalf."

Reference has been already made to the arrangement which it is proposed to carry out for the supply of water to the New River Company. The notice specifies that in this respect the Bill is "to empower and, if need be, to require the West Middlesex Company and the Grand Junction Company, and the Governor and Company of the Chelsea Water-Works, upon such terms (pecuniary and other) and conditions as may be agreed or determined by arbitration or prescribed by the Bill, to carry and convey water from any of the works proposed to be authorized by the Bill" by means of any of their existing or future mains or pipes, to the mains and pipes of the New River Company, and "to enable all or any of the Companies mentioned in the notice to enter into and carry into effect agreements with reference to any of the objects or purposes of the Bill."

Turning to the notice given by the New River Company, we find that they intend to apply for power to carry out an extensive series of works, which may be briefly enumerated as follows: A well and pumping-station, to be called the Mardock station, in the parish of Ware Rural; the West Mill Farm well and pumping-station, also in Ware Rural; the Stapleford well and pumping-station, at Stapleford, in Hertfordshire; the Tewin well and pumping-station, at Tewin, in the same county; the Essendon well and pumping-station, at Essendon, also in Hertfordshire; the Blakefield well and pumping-station, at St. John Rural, in Hertfordshire; fourteen aqueducts or pipe-lines, in connection with the several works; a storage reservoir, to be called the Enfield Chase reservoir, and the diversion of a watercourse, at Enfield; a subsiding reservoir (the Highfield reservoir) at Southgate; the enlargement of an existing subsiding reservoir at Wood Green; filter-beds and a pumping-station at St. Mary's, Stoke Newington; the enlargement of the existing service reservoir near the Grove at Hampstead; the widening of the New River; and the discontinuance of part of the waterway. Power will be sought to purchase additional lands in the counties of Hertford and Middlesex; and to acquire by compulsion or agreement other lands specified. The Company will ask to be allowed to enter into agreements with sanitary authorities, public bodies, &c., with respect to the supply of water; and to use their existing capital and raise additional money for the general purposes of their undertaking. The Bill to be applied for will amend and enlarge the Charter granted to the Company by James the First, and, so far as may be necessary, the other Acts relating to the undertaking. The earliest of these are 13 Eliz., cap. 13; 3 Jas. I., cap. 18; and 4 Jas. I., cap., 12. Other Acts were obtained under the second, third, and fourth Georges, as well as during the present reign; the last being the 42 Vict., cap. 10.

The Southwark and Vauxhall Water Company's notice is for a Bill to enable them to construct large new reservoirs and carry out other works. The latter comprise a well, adits, and pumping-station (the Springwell station) at Harefield; another pumping-station (the Harefield Moor station) also at Harefield; four storage reservoirs, each having a superficial water area of 250,000 square yards, at Walton-upon-Thames; and various conduits or pipe-lines passing through Harefield, Hillingdon, East and West Hillingdon, Uxbridge, Southall, Hayes, Norwood, Heston, Isleworth, Twickenham, Hampton, Hayes End, Walton, and West Molesey. Power will be sought to purchase lands and easements, to connect various portions of the works, to purchase or otherwise acquire water in bulk, &c. Additional share and loan capital will be applied for; and special provision is to be made as to the manner of raising it.

The Quality of the Water in October.

The returns furnished to the Registrar-General by the London Water Companies regarding the water supply in the Metropolis during October, show that the average daily supply amounted to 215,433,126 gallons, as compared with 192,939,209 gallons in the corresponding month of 1894. The number of services being 822,124, the rate was 262 gallons to each service. Of the entire bulk of water sent out, 113,597,502 gallons were drawn from the Thames, and 101,835,624 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: Taking the average amount of organic impurity in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health was: Kent, 0·8; Tottenham, 0·9; New River and Colne Valley, 1·2; East London, (deep well) 1·6, (river supply) 2·1; Chelsea, 2·3; West Middlesex and Southwark, 2·7; and Grand Junction and Lambeth, 2·8. The unfiltered river waters contained the following proportions: Thames at Hampton, 4·6; New River Cut, 1·9; and the Lea at Angel Road, 3·4. The Thames at Hampton was, on Oct. 16, turbid and yellow in colour, and of moderately good chemical and bacterial quality. As delivered by the five Companies drawing from this river, it was in every case efficiently filtered, and of excellent chemical and bacterial quality for dietetic purposes. The bacterial improvement effected by the various Companies is expressed by the following percentage numbers: Chelsea, 99·84; West Middlesex, 99·03; Southwark, (No. 3 filter well) 99·52, (No. 8 filter) 99·61; Grand Junction, (general well at Hampton) 99·35, (general well at Kew Bridge) 98·23, (south well at Kew Bridge) 99·84; and Lambeth, 99·52. The New River Cut, before entering the subsidence and storage reservoirs, was, on Oct. 18, turbid and very pale yellow in colour. It was of excellent chemical, and fairly good bacterial, quality. By passing through the storage reservoirs, the number of bacteria was reduced to less than one-third; and, after efficient filtration, the water was delivered to consumers in excellent chemical and bacterial condition for dietetic purposes. Bacterially it was improved before delivery to the extent represented by the following percentage numbers: General filter well, 99·29; No. 7 filter well, 99·29; and No. 9 filter well, 98·93. The water taken from the Lea by the East London Company at Angel Road on Oct. 18 was of very good chemical, and fairly good bacterial, quality; but it was turbid and pale yellow in colour. After storage for 15 days, more or less, the number of bacteria per cubic centimetre was reduced to little more than one-third. It was efficiently filtered before delivery, and was improved bacterially to the extent represented by the following percentage numbers: No. 1 Essex well, 99·12; and Middlesex well, 99·56. The deep-well waters of the Kent, Colne Valley, and East London Companies, and of the Tottenham Local Board of Health, were of excellent quality for dietetic purposes; and, with the exception of the Tottenham sample (which was very slightly turbid), they were perfectly clear and bright without filtration. The Colne Valley Company's water had been softened before delivery, and thus rendered suitable for washing. Seen through a stratum 2 feet deep, the New River, Kent, and Colne Valley waters were clear and colourless; the East London (deep well), clear and nearly colourless; the Tottenham very slightly turbid and colourless; and the remaining waters, clear and very pale yellow. The bacterioscopic examination of the raw river waters before and after storage, and the supplies delivered by the various Companies and collected on the 16th, 17th, 18th, and 19th of October, yielded the results contained in the following table:—

Description.	No. of Microbes per Cubic Centimetre.	Temperature in Deg. C.
Raw and Stored River Waters.		
Thames at Hampton, Oct. 16	2480	11·5
Thames, after storage for 14·7 days (Chelsea Company), Oct. 16	1240	12·3
Lambeth Company's water passing on to filter No. 5, Oct. 16	480	12·2
West Middlesex Company's water (supplying filters 1–5), Oct. 17	220	11·0
Grand Junction Company's water at Kew, passing on to filters 2, 3, 4, 5, and 7, Oct. 17	340	12·5
New River Cut, before passing through reservoirs, Oct. 18	1120	9·8
New River Cut, after passing through reservoirs, before filtration, Oct. 18	340	10·4
River Lea at Angel Road, Oct. 18	1820	10·0
River Lea, after storage for 15 days (East London Company), Oct. 18	640	10·6
Filtered River Water as Supplied.		
Thames—		
Chelsea Company's general filter well, Oct. 16	4	12·5
West Middlesex Company's general filter well, Oct. 17	24	11·0
Southwark Company's No. 3 filter well, Oct. 16	12	11·7
Southwark Company's No. 8 filter well, Oct. 16	84	11·7
Grand Junction Company's general filter well at Hampton, Oct. 16	16	12·1
Grand Junction Company's general filter well at Kew Bridge, Oct. 17	44	12·0
Grand Junction Company's south filter well at Kew Bridge, Oct. 17	4	12·0
Lambeth Company's general filter well, Oct. 16	12	12·3
Lea—		
New River Company's general filter well, Oct. 18	8	10·4
New River Company's No. 7 filter well, Oct. 18	8	10·5
New River Company's No. 9 filter well, Oct. 18	12	10·4
East London No. 1 Essex well, Oct. 18	16	10·0
East London Middlesex well, Oct. 18	8	10·0
Deep-Well Waters.		
Kent Company's new well at Deptford, Oct. 19	0	11·3
East London Company's Lea Bridge well, Oct. 18	4	11·3

It deserves to be remarked that the Kent Company's new well at Deptford yielded water which was absolutely sterile; while the supply of the Chelsea Company, Grand Junction Company (from their south well at Kew Bridge), and the deep-well water of the East London Company contained only 4 microbes per c.c.

In their report to the Official Water Examiner (Major-General A. de Courcy Scott, R.E.) on the composition and quality of the water supplied in London during October, as ascertained by tests of samples taken daily on behalf of the Water Companies, Messrs. Crookes and Dewar say: Of the 189 samples examined, all were found to be clear, bright, and well filtered. We have this month to record an excess of rainfall; the quantity measured at Oxford being 2·85 inches, compared with 2·56 inches (the average for 25 years)—showing an excess of 0·29 inches. The rain was fairly well distributed throughout the month, though more fell in the first ten days than later on. There were 15 days on which no rain fell. Compared with the corresponding month of last year, the quality of the Thames-derived waters shows a marked improvement in every respect; and, in spite of a much heavier rainfall than in September last, the results are almost identical. Our bacteriological examinations give the following results:—

	Colonies per Cubic Centimetre.
Thames water, unfiltered	2603
Do. from the clear-water wells of the five Thames-derived supplies . highest	108
Do. do. lowest	30
Do. do. mean	68
New River water, unfiltered	1577
Do. from the Company's clear-water well	41
River Lea water, unfiltered	3018
Do. from the East London Company's clear-water well	48

These results show that the Water Companies are able to successfully cope with the extra strain put upon them; their filtering appliances being in excellent condition.

Wages of Leeds Gas Workers.—The Gas Committee of the Leeds Corporation last Thursday had under consideration an application from the Gas Workers and General Labourers' Union for improved conditions of employment for about 150 pipe-layers and others in the service of the Corporation Gas Department. The demands of the men were as follows: "Foremen: In place of the four classes, 28s., 32s., 36s., and 40s., we suggest 30s., 33s., 36s., and 40s.; diggers, plumbers' labourers, masons' labourers, flaggers' labourers, and watchmen, a minimum of 23s. per week; setters up, 25s. per week. Flaggers: Men at 21s. and 22s. to be advanced to 24s. Other flaggers to be advanced 2s. per week. Meter fixers: A number of these men were reduced last March from 25s. to 21s., on the grounds of incompetency. They are still sent out to perform the same work as heretofore; and, such being the case, we ask for a minimum of 25s. per week." The Committee practically accede to all the points asked.

WEST MIDDLESEX WATER-WORKS COMPANY.

The Half-Yearly General Assembly of this Company was held last Tuesday, at the Offices, Marylebone Road, N.W.—Sir W. H. WYATT in the chair.

The CHIEF CLERK and SECRETARY (Mr. F. H. Wybroo) read the notice calling the meeting; and the report of the Directors was taken as read. He afterwards read the Auditors' report for the six months ended Sept. 30, which stated that the capital of the Company remained the same as in the previous half year—viz., £1,432,636—and that the total expenditure on works amounted to £1,445,047, including £43,196 spent in the past half year. The revenue had been £127,257; being an increase of £1566 on that of the corresponding period of 1894. The water-rental received was £108,795; and the balance to the credit of the dividend and interest account was £43,165.

The CHAIRMAN said he feared the proprietors would be almost tired of hearing him say that the Directors had had an anxious time, for he had told them this for a good many years. Still, he did not think the past half year gave them less anxiety. They began now, however, he hoped, to see a little more daylight, and more peace and quiet; but the way in which they had been harassed, and the expense to which they had been put were really abominable. Though the outlay did not seem so large this time for parliamentary expenses, this fact was attributable to the circumstance that in the previous half year, foreseeing what was coming, they were prudent in putting by something to meet it. But if they had had to charge all the expense this half year, they would have had to put down a very large sum. The London County Council did not care, as they were not spending their own money; whereas the Directors were spending the shareholders' money, and they were also made to pay a good deal of the expenditure which the County Council themselves incurred. He was, however, glad to say that, since he last saw the shareholders, there had been a fresh election; and no doubt there had been a considerable improvement in that body, who were not so disposed to act unfairly towards them as their predecessors had been. As the proprietors were aware, the County Council brought in last year eight different Purchase Bills affecting the Water Companies; and the expense which each Company would be put to in opposing these Bills would be not less than £2500, or £20,000 in all. Each Company had to pay its own costs. It had been intended to go on with all these Bills. But, happily, by a majority of one, it was decided that they should not go on; so they were free from this anxiety for some time. Still one did not know what the Council might bring forward. The Company's supplies continued to increase; and the Engineer (Mr. M. W. Hervey, M.Inst.C.E.) assured them that all their works were in excellent condition. He thought he should be ungrateful if he did not take this opportunity of acknowledging the skill and care with which the Engineer had planned the new works; and he must also recognize the energy with which the Contractors were carrying them out. They gave the Directors hope that they might have two of the large reservoirs ready for use next summer; and this would greatly facilitate the supply of the district. They had raised £100,000, which was the first portion of the £440,000 of 3 per cent. debenture stock which they were authorized to create at their special meeting last May. It was repayable in 25 years, if they pleased, at £105. The tenders were for five times the amount offered; and those accepted averaged £105 10s. 2d. per cent. Of course, they allotted the stock, as they were bound to do, to the highest bidders. Some of the proprietors thought it was "hard lines" that they should have none of it; but the Directors would have been very glad to give it to them if they could. He thought it was very satisfactory to see the amount obtained for the stock. The price of their shares also had been, and was, very high; showing, he thought, that the public had confidence, and did not believe that the County Council would be allowed to acquire the Company's undertaking without paying a fair price for it. The inquiry before the Select Committee of the House of Commons with regard to the transfer of the various undertakings did not come to anything, because Parliament dissolved, and the whole thing broke up. But the Board thought it was very fair to the Water Companies; and the Committee would not listen to the proposal that their undertakings should be bought up for old iron. They intimated pretty plainly that, if they were purchased, a reasonable price would have to be paid—not a price, he supposed, which would be satisfactory to them, but still something reasonable. Several inquiries had been going on with reference to the waste of the water; but he could not say anything definite about this matter yet. So far as they could judge, they thought the evidence was in the Companies' favour. At the meeting last half year, the Directors reported the dreadful effects caused by the unwonted frost; and they came to the conclusion afterwards that the best thing they could do was to lower all the pipes to a depth of 3 feet wherever it was practicable to do so. They had now done this, but at a cost of £19,000. This was heavy; but they hoped they had now protected themselves against the effects of weather as severe as that of last winter. The difficulty was that many of the consumers had not taken any precaution against their pipes freezing again; but he did not know that the Company could help this. Their own pipes would be quite free from this danger. To meet the expenditure, two courses were open. One was to reduce, if not altogether to abolish, the 10 per cent. rebate which they allowed to the consumer, or to borrow the money temporarily from the reserve fund. They thought that, on the whole, it was better to take the money from this fund, and pay it back year by year by such instalments as they could; and a special resolution on the subject would be submitted at this meeting. The accounts had been certified by Mr. Allen Stoneham, the Official Auditor, who wanted them to charge a certain proportion of the £19,000 to capital. They told him they did not think it was necessary to do this, though there was something to be said in favour of it; and they promised to consider the matter next time. Mr. Stoneham pointed out that he had to adopt a uniform plan for the Water Companies; and he therefore hoped that the Company would agree to what he had suggested. He had since intimated to another Water Company that he thought about one-sixth would be the right proportion. One could not, however, tell. But the point was not of much importance; and they thought it was best to carry out Mr. Stoneham's views as far as they could. Next half year, therefore, they would charge to capital such a proportion as he might decide upon. He concluded by moving the adoption of the report and accounts, together with the report of the Company's Auditors.

The DEPUTY-CHAIRMAN (Mr. Edmund Boulnois, M.P.) seconded the motion; and it was carried unanimously.

Resolutions were afterwards passed authorizing the transfer of any sums not exceeding in all £20,000 from the reserve fund to dividend and interest account; declaring a dividend on the consolidated stock, for the half year to Sept. 30, at the rate of 10 per cent. per annum; and thanking the Auditors and the Chairman and Directors.

The proceedings then terminated.

THE PROPOSED WATER TRUST FOR WEST KENT.

Last Wednesday, a meeting of representatives of Local Authorities of West Kent was held in connection with the scheme on foot for obtaining parliamentary powers to form a Water Trust for the purpose of acquiring the undertaking of the Kent Water Company, and so much of that of the Lambeth Water Company as is situated in the county of Kent. Mr. Baker, the Chairman of the Beckenham Water Committee, presided; and he opened the proceedings by explaining that, though the London County Council were stated to have withdrawn their Water Transfer Bills, this was not actually the fact; indeed, the Council might be compelled to proceed with them, in order to render effective their opposition to those which would be promoted next session by the several Water Companies, with a view of extending their own powers. A series of resolutions which had been prepared were then submitted to the meeting. The Chairman moved the first, as follows: "That a Bill be prepared and deposited, and the necessary notices given of an application to Parliament for power to constitute a Water Trust for West Kent, and to purchase the undertaking of the Kent Water Company and so much of that of the Lambeth Water Company as is situate within the county of Kent." Some objections being raised, the Chairman stated that it was not proposed to proceed with the suggested Bill unless the London County Council went on with their Bills. Mr. Pember had advised that the position would be strengthened, in case of a renewed application by the Council, if the Kentish authorities promoted a Bill to run concurrently with the London Bills. After some discussion, the motion was carried, with the addition of the following words: "All questions of retaining Counsel and obtaining expert evidence to be deferred for future consideration by the Committee, and up to the meeting of Parliament, no expense be incurred except the actual and necessary cost in relation to the preparation of the notice and deposit of the Bill." It was also resolved that each authority should remunerate its own legal representative; but that all other charges are to be borne by the authorities joining in the promotion of the Bill, in proportion to the rateable value of the districts.

The notice for the Bill has now appeared. It sets forth that application will be made for power to constitute a Water Board for the urban districts of Beckenham, Bromley, Dartford, Erith, and Bexley, and the rural districts of Bromley, Dartford, and Sevenoaks, all in Kent. It is proposed to purchase the undertaking of the Kent Water Company, and so much of that of the Lambeth Water Company as is situated in Kent, and vest the same in the Board; the Kent Company being dissolved. The Board are to be empowered to maintain and improve the existing works, and to enter into agreements with other authorities for the sale of water in bulk; also to "transfer the portion of the undertaking of the Kent Company within the County of London, or part thereof, and with or without the sources of supply, works, wells, and pumping-stations, to the London County Council, or to any company or authority that has been or may be established by Parliament for the supply of water within the County of London." The Bill to be promoted for carrying out the above-named objects will contain provisions as to levying rates and charges and the borrowing of money, and enabling the Board, within their water limits, to exercise the powers of an Urban Sanitary Authority under the Public Health Acts, 1875 and 1878, and the Acts amending them, with respect to the supply of water.

BIRMINGHAM CORPORATION WATER BILL.

The Water Committee of the Birmingham Corporation have prepared a report for presentation to the Council, in which they submit the Water Bill which it is proposed to promote in the coming session of Parliament, and comment upon its provisions. The object of the Bill is this: The provisions of the Railway Clauses Consolidation Act, 1845, with respect to the temporary occupation of lands during construction of works (including use of land for the deposit of spoil), so far as regards their application to the aqueduct, were taken out of the Corporation Act of 1892 by the Lord Chairman of Committees. In addition to this, clauses were inserted in the Act for the protection of many large landowners, under which land for the deposit of soil could only be acquired by agreement. The result has been that great difficulty has been experienced in acquiring spoil banks on anything like reasonable terms. The present Bill is drafted so as to give the Corporation compulsory powers in this respect. The Bill also seeks powers to construct a short line of railway from Rubery Station on to the land of the Corporation at Frankley, for the purpose of conveying stone, cement, and other materials to the works at Frankley reservoir and filter-beds. The Water Committee have practically arranged with Lord Cobham, the only landowner interested, on what they consider to be reasonable terms. The Bill also provides for two short deviations of the aqueduct. There are, besides, some technical clauses designed to meet difficulties which have arisen from time to time in the construction of the works. The estimate for the execution of the works and purchase of lands under the Bill is £110,000. It should be clearly

understood, however, that the whole cost of the undertaking from first to last has been provided for in the Act of 1892; and the Committee hope that the estimate of expenditure under the Act of 1896 will stand in place of a greater expenditure which would have been incurred under the 1892 Act. The estimate is only inserted in the present Bill to comply with the Standing Orders of the Houses of Parliament, and does not involve any additional outlay. For the above reason, no further borrowing powers are sought under the new Bill. When the Bill has received the approval of the Council, it will be necessary to hold a public meeting of the ratepayers of the city to authorize the application to Parliament.

THE NEW WATER-WORKS AT WESTMINSTER (BRITISH COLUMBIA).

A recently-issued volume of the Proceedings of the Institution of Civil Engineers contains an account, by Mr. A. E. B. Hill, M.Inst.C.E., of the new water-works at Westminster, British Columbia. The town, which has a population of 8000, is situated about 15 miles from the mouth of the Fraser River; and in 1885 a scheme was prepared for supplying it with water in conjunction with Vancouver. A special Board of Water Commissioners was established, to which Mr. Hill was appointed Engineer, with instructions to prepare plans and specifications of works to meet the existing and prospective needs of the rapidly-growing city. This was done, and the scheme completed.

The source of the supply is the Coquitlam Lake—a body of water of unexceptional quality—about seven miles long and between half and three-quarters of a mile wide. The depth has not been measured; but it is known to be considerable. The lake is surrounded by lofty mountains, which guard it from contamination, and is fed from snow-fields. The lowest level of the lake is 435·8 feet above high-water mark. It is subject to sudden rises of 9 feet or 10 feet, which, however, never impair the purity of the water. The nearest part of the lake is 71,581 feet from the reservoir at New Westminster by the pipe-line. The supply is practically unlimited in quantity.

There are two inflow-pipes, so as to guard against the results of an accident happening to one of them. These pipes deliver the water into a screen chamber, 3 feet in diameter and 18 feet high. This consists of eight castings, one of which is a heavy bed-plate; the rest being cylinders of 1-inch metal with spigot joints, and having suitable branches for connecting with the mains. The chamber contains vertical channel-iron guides for the screen-frames. The screens are of copper wire, 7 and 14 wires to the inch, in wooden frames about 34 inches square. A small wooden building above the screen chamber accommodates the caretaker or patrolman. The ground along the pipe-line was cleared to a width of 33 feet. For a considerable distance from the town, the line follows a previously existing public road; and for the remainder of the distance, a waggon road has been made and declared public. Along the old road the ground is of easy slope; but after leaving it, the line is generally along steep hillsides and across bluffs, with occasional stretches of swamp. There are numerous streams, some of which were underrun and others bridged. On the hillside ground, a bench was cut for the roadway, and the pipe-trench cut on the inner side of it.

Except at one point, where the line was carried over a high bluff to reduce the length, it was kept below an imaginary line of uniform gradient, drawn from the source to a certain point in the city. At any future time, therefore, by laying a link round the bluff in question, the pipe-line could be made available for supplying, at its full capacity, an additional reservoir at any point that might be chosen in the city. In locating the pipe-line, it was purposely carried over a number of points of considerable elevation and almost precipitous slope; thus dividing the line into a series of sections, any one of which could be discharged for repairs without emptying the others, and without the shock and strain arising from the use of stop-valves on the main.

In the streets, the pipes were laid at a mean depth of 5 feet; on highways, at about the same depth; in heavily-timbered forest land, at 5 to 6 feet; in light timber, at 4 to 5 feet; and on steep hillsides at 7 to 10 feet. The gradients vary between 1 in 100 and 87 in 100. Angles of less than 4 degrees were passed without special pipes. For larger angles, cast-iron bends were used, and changes of gradient were made to coincide with alterations of direction as far as possible, so as to economize in the number of bends used. The main is 14 inches diameter throughout.

The steel plate of which the main was constructed was manufactured under a specification requiring a tensile strength of 65,000 lbs. per square inch, and an elastic limit of 39,000 lbs. per square inch, with an extension of 20 per cent. on 10 inches. The plates and other material were supplied from Glasgow, and put together by the Contractors at shops established for the purpose in New Westminster. Each plate was bent in rolls, and lap-riveted with two rows of rivets. The circular joints were also lap-riveted with single riveting; the plates being sheared to such a size as to make an exact fit between the smaller and larger pipes. Four of the larger and three of the smaller pipes were riveted together to form a 25-feet length. Each length was then tested by hydraulic pressure, cleaned, and coated, and taken to the ground for laying. A thimble made from 5-inch strips, of the same thickness as the pipe, was riveted on the inside of one end of each length, projecting to fit into the end of the next length. A sleeve made from 5 in. by $\frac{3}{8}$ in. iron was passed over the joint, and set up with lead in the usual way. The pipes were of four classes; the thickness varying according to the pressure to which the pipe might be exposed. The four thicknesses were Nos. 9, 10, 11, and 12 B.W.G.—or 0·148, 0·134, 0·120, and 0·109 inch. The hydraulic tests with these plates corresponded to heads of 675, 625, 525, and 425 feet respectively. The corresponding rivets were $\frac{21}{32}$, $\frac{19}{32}$, $\frac{17}{32}$, and $\frac{15}{32}$ inch in diameter at a pitch of $1\frac{13}{16}$, $1\frac{6}{16}$, $\frac{23}{32}$, and $\frac{5}{8}$ inch respectively. Tight joints were obtained throughout the work. Trenching for the main commenced about Dec. 1, 1891, and laying about Dec. 14. The water was turned into it on Aug. 8, 1892.

The reservoir is on a ridge about a mile from the city, from which it is separated by a deep ravine. It is in good clay which formed excellent material for the banks. The reservoir was made by day labour under the author's direction; and the castings, valves, &c., were obtained from Victoria. The reservoir is rectangular, measuring 150 feet by 80 feet on the bottom, and with a depth of 15 feet; the capacity being about 280,000 cubic feet. The water-level is 400 feet above the city datum—404 feet above high-water mark. The outflow main from the reservoir is 22 inches in diameter, of steel plate, Nos. 9, 10, and 11 B.W.G., jointed and laid in the same way as the 14-inch main. A gate chamber, 6 feet by 8 feet inside, was formed over the valve at the outflow, built of 4-inch cedar plank. It also contains a 6-inch open-topped pipe, which serves instead of an air-valve. There is a 6-inch waste-pipe, from an overflow tank, delivering to a surface drain.

The 22-inch main has seven bends, five of which were of 90 degrees, and constructed for convenience in two lengths. There are four 4-inch air-valves, a 6-inch relief, and two 10-inch blow-off valves. The 22-inch main connects with the two 14-inch steel plate mains of the distribution system. On one of these is a relief tank, 20 feet in diameter and 6 feet deep, of brick laid in Portland cement mortar, rendered with $\frac{1}{2}$ inch of neat cement. By means of this tank, the pressure in the lower parts of the city is reduced; only the upper parts carrying the direct head of the reservoir. This was necessitated by the difference of level, amounting to 300 feet, between the upper and lower districts. In case of fire in the lower district, the full reservoir head can be made available; the two districts being cut off from each other by two 14-inch and two 6-inch valves. The service-mains are chiefly 6 inches in diameter, of which size 89,936 feet have been laid. There are 73 hydrants (of the Galvin pattern) established. The pipes were laid, as a rule, 15 feet from the street boundary, with a stop-valve 4 feet from each street intersection. Every summit and dead-end is provided with an air-valve; there are eleven 6-inch relief-valves on the system. Care was taken to have no summits except at intersections. The house connections are partly of lead and partly of ungalvanized wrought-iron piping. The trenches were 2·95 feet wide on the average, at the top, and 3·82 feet deep. The cost to the city for trenching and laying was 11·4d. per foot run for 6-inch pipe, and 10·7d. for 4-inch pipe.

The condition of the works since the opening has been satisfactory. During the winter of 1892-3 a trying ordeal of flood and frost was experienced without any interruption of the water supply. When the temperature of the air was 12° Fahr. below zero, that of the water in the reservoir was 37·5° Fahr. The 14-inch supply-main, where exposed for about 1000 feet, was carefully watched, and was always found to liquefy snow placed upon it.

The capacity of the supply-main at the mean head is about 110,000 cubic feet per day. The capacity of the 22-inch main below the reservoir is sufficient to meet a fire draught of 200 cubic feet per minute, besides the ordinary domestic wants of a population of 22,000. In consequence of the efficiency of the supply, insurance rates have been reduced in the city by an amount exceeding the water-rate.

The following table gives an abstract of the cost of the works up to December, 1892:—

Franchise		$22,033·27
Land, buildings, and materials in stock		13,765·47
Works—		
Screen chamber	$1,148·61	
Patrol-house	620·99	
Supply-main (including clearing)	184,023·14	
Service reservoir	17,921·29	
City mains	44,370·36	
Relief-tank	2,325·55	
Distribution system	110,614·16	
House-service	5,490·18	
Extensions not included in original designs	3,340·57	
		369,854·85
Total		$405,653·59 or about £81,130.

In this abstract, the cost of engineering, law expenses, &c., has been distributed *pro ratâ* over the various items. The cost of engineering surveys was 4·24 per cent. of the total; and the general charges were 1·68 per cent.

The Gorton Sewage Works.—To mark the completion of the Gorton sewage scheme, a ceremony recently took place at which Dr. B. W. MacArthur, the Chairman of the Gorton Urban District Council, set the works in operation. An opportunity was afterwards given to visitors to view the process selected. Before the adoption of the scheme, the whole of the sewage of the township went into Gorton Brook and Gore Brook without having received any treatment at all. The Mersey and Irwell Joint Committee, however, served the Council with a notice requiring them to divert the whole of their sewage from the streams within a given time. A scheme was, therefore, prepared dealing with the entire township, and consisting of main concentrating and several tributary sewers. Application was then made to the Local Government Board for sanction to borrow the necessary money, which was estimated in round figures (and including the cost of the land) at about £40,000. An inquiry was held at which opposition to the scheme was made by the Manchester Corporation, on the ground that the effluent would drain into a stream (the Gore Brook) which flowed through the city. The Local Government Board, however, gave their approval to the plan, and sanctioned the loan which its adoption involved. A convenient plot of ground was secured; and the first sod was cut in 1893 by Mr. T. Matthews, the then Chairman of the Local Board. The Engineers were Messrs. Lomax and Lomax, of Manchester; and under their direction the work has been carried out by Mr. D. Eadie, of Stockport. There are two detritus tanks with a capacity of 110,000 gallons, and three large precipitating tanks with a combined capacity of 1,079,000 gallons. It is intended, in future, to deal with the sludge deposited in the tanks by means of filter-presses; but this is not yet included in the scheme. The outfall works have cost £17,000; and the concentrating sewers have involved an expenditure of £8000 more. Other important sewers are about to be carried out, and, when completed, the whole of the sewage from the township will be conveyed to the outfall purification works, and the pollution of the rivers, so far as Gorton is concerned, will be at an end.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Dunfermline Town Council held a special meeting on Monday; being the second meeting, in terms of the Burghs Gas Supply Act of 1876, to consider as to the adoption of that Act. Provost Walker, who presided, said that a remark was made to him the other day, which led him to see that there was a misconception on the part of a considerable number of the community on a very important matter. He was told that there was some opposition to the proposal, in consequence of a large number of people thinking that, if the town purchased the gas-works, it would mean an additional amount of taxation to the burgh. If he thought that was to be the case, he would never have brought forward the proposal. His object had been to lessen rather than increase the taxes of the burgh. In every case about which he had obtained information, the result had been satisfactory so far as money-making was concerned. He had taken pains to write to a goodly number of towns in which the electric light had been introduced. He took thirteen places where it had been in use for a considerable number of years, or where it had been lately introduced; and he had had twelve replies. The general outcome of the letters was that the financial results had been unsatisfactory. He had made a summary, which was as follows: Two years, a loss each year; six years, less than 1½ per cent., or, deducting interest, £6000; bad financial results, a loss each year since commencing; large loss, several years, average 3¾ per cent., by charging 25 per cent. higher than Board of Trade unit, if at 6d., a loss last year of £1300; gross profit, £2000, net result not given; a loss for past year; considerable loss; loss of £1350; not hopeful financially; hope to make pay. He did not wish to infer from this anything against the electric light; but he did say that it was a luxury, and as a luxury had to be paid for. It was for that reason that he thought it would not be suitable for Dunfermline, and that it would be better to have the gas-works. There were hundreds of houses in Dunfermline into which one would not think of introducing the electric light, so that although they had this illuminant they would require the gas as well. The Provost put the subject very sensibly. A question was asked as to whether the adoption of the Act implied that the Corporation must proceed with the transfer, the answering of which appeared, unnecessarily, I think, to be difficult; but in the end it was authoritatively laid down that they would not be bound to proceed. The adoption was then agreed to unanimously; and the Town Clerk has issued the statutory notice calling for objections on the part of ratepayers. There would appear to be a feeling in the minds of some that they should not proceed with the transfer, but should hold the threat over the head of the Gas Company that, unless they give easy terms to the town, the Council would exercise their powers under the Act. I dare say such a threat would not do much harm; but if there be anything in it, the statute seems to give every facility for the use of it. No limit is placed to the time in which the powers under it may be put in force; and the threat might thus be a perpetual one. I trust that good sense will prevail; and that this state of matters will not arise.

The Aberdeen Town Council have re-appointed Mr. Johnston Convener of the Gas and Electric Lighting Committee. During election times many new ideas are put forward which are never heard of again. On this occasion, when the Council were on the subject of appointing Committees, Mr. J. Gray brought forward one of these suggestions, in the proposal that the Gas and Electric Lighting and the Water Committees should be conjoined. His notion was that if one Committee were in charge of all the works which require the streets to be opened, the scandal of one Committee opening a street and almost as soon as they had finished their work another following, would be got quit of; the result being that the thoroughfare is ruined and the residents are put to great inconvenience. Mr. Gray's proposal was well meant; but it was vetoed, the Lord Provost intimating that the officials said it would not work at all. That may or may not be the case; but where Mr. Gray's motion was weak was that it did not go far enough. It should have included the Roads and the Cleansing Committees, because these have to do with the paving of the streets and the laying of sewers. With those Committees added, there would practically have been the whole Council; and the scheme would certainly have been as unworkable as it is at present. The indiscriminate opening of streets is a crying scandal which exists in every town; and for it the officials are largely to blame, because they frequently do not work together. No remedy has yet been found, though attempts have been made to arrange for one Committee intimating to another their intention to open up a certain street. The solution of the difficulty would, of course, lie in the Roads Committee intimating that they proposed to pave a certain street, and then the other Committees putting their pipes in order before it was done; but then no Committee cares to spend money until it is absolutely required, and such a scheme would interfere with the estimates which they had adopted for the year. It would also make the Roads Committee the dominating one, which some Conveners would not tolerate; there being a certain jealousy between departments. That feeling ought to be overcome, in the public interest; and if a remedy is to be found, it should begin with the framing of the estimates for the year—that is to say, before the time for adopting these arrives, the Roads Committee should make up their minds which thoroughfares they are going to pave during the year, and communicate with the other Committees on the subject. These could then make provision, in their estimates, for overhauling their pipes. Such a scheme might involve outlay which was not immediately contemplated; but there would be a saving in the end, not to speak of the comfort that would be secured to the community, which should make some scheme of the kind workable.

For the filling up of the vacancy caused by the retirement of Mr. Thomas Whimster, Manager of the Perth Corporation Gas-Works, 43 applications have been received. The Commissioners met in private on Monday night; and out of the list, they selected the following nine as a short leet: Mr. Alexander Yuill, Corporation Gas-Works, Alloa; Mr. Andrew Wilson, Gas-Works, Carlisle; Mr. G. W. Anderson, Gas-Works, Whyteleaf, S.O., Surrey; Mr. David Easson, 13, Queen Street, Perth; Mr. George R. Love, Gas-Works, Dundalk, Ireland; Mr. James M'Cubbin, Gas-Works, Port Glasgow; Mr. W. S. M'Gregor, Gas-Works, Leslie; Mr. William M'Crae, Gas Commission, Dundee; Mr. Edward A. Harman, City Gas-Works, West Bromwich.

The inhabitants of Forfar are still in a state of agitation over the explosion in the gas-works a fortnight ago. One individual, who resides in the neighbourhood of the works, urges the Gas Corporation to have a searching inquiry by "a competent gas expert," whatever that may mean; otherwise there will be a general exodus from that district of the town. He considers that "to stay in a locality where there is a certain amount of danger is bad enough; but to remain hourly in expectation of being blown into eternity is still worse." Was ever such bunkum written? But for the fact that Mr. Waddell was burned by it, the explosion was a small affair, but it is being made use of by some who are opposed to Mr. Waddell's policy to depreciate his work; and as, unfortunately, his opponents have a considerable footing in the Corporation, the effect is damaging. Apart from that, it is bad taste of anyone, while Mr. Waddell is not yet able to defend himself, to attack him in this covert way. It would be too glaring a piece of injustice to speak such sentiments at a public board; and, as a matter of fact, at a meeting of the Corporation on Monday night, the subject was passed over, on account of Mr. Waddell's condition of health. But an anonymous letter in a newspaper is a convenient method of hitting a man from behind; and it has been resorted to, I do not say by any member of the Corporation, but by someone in sympathy with the opposition. This is very shameful; and more particularly when Mr. Waddell is down, which at present he in reality is.

As to the meeting of the Corporation on Monday night, it is almost amusing to see the extraordinary interest which is taken in their doings at present. One local newspaper even goes the length of publishing a diagram showing where each member of the Corporation and the officials sat, which betokens an abnormal and unhealthy feeling in the community. The business was not particularly important. A Convener of the Committee had first to be appointed. The Provost moved that Mr. Craik, who has been a very capable Convener, should be re-appointed. A member thought that someone else should be elected, as Mr. Craik had been Convener for such a long time, and he lived too far from the works. Two names were proposed in succession; but neither of the gentlemen would accept the office, and in the end Mr. Craik was re-appointed. Mr. Christie then said he was to have moved that the power to dismiss workmen should be vested in the Gas Committee, instead of in the Manager; but he could scarcely go on with this motion at the present time, owing to the unfortunate position in which their Manager was placed. It was impossible to fully discuss this matter without introducing the name of the Gas Manager; and he asked that his motion be allowed to stand over to next meeting. This was agreed to. On account of a charge which was made by a member of the Corporation at a public meeting during the recent election, to the effect that there was cheating going on in the selling of coke, the Committee recommended that the coke be sold at the rate of 10s. for 33 bags, delivered in town; no coke being sold by weight in future. Mr. Craik said that the bags used at the gas-works had got less and less, until it required about 41 bags to weigh 18 cwt. They were to get a bushel measure; and the coke would then be sold by the bushel. Mr. Christie said he would certainly object to this method of selling coke, as he did not think the Corporation should encourage their officials to bolster up their finances in this manner. If a man purchased a ton of coke, he ought to get a ton. Mr. Craik said that they could not guarantee any weight when selling coke. If anybody was cheating, the whole Corporation were cheats. With this beautiful sentiment, the matter was allowed to drop; and the Corporation went into the subject of the sale of the residuals. The only other matter taken up was the explosion, regarding which Mr. Craik intimated that, as soon as Mr. Waddell had recovered and was able to attend, they intended to have an investigation by the whole Corporation. Mr. Christie asked if it was not necessary to report the occurrence to the Board of Trade. The Clerk replied that he had sent notice according to the statute, and had also reported the matter to the Factory Inspector. Mr. Christie thought it was necessary to ask the Board of Trade to send an Inspector to make an inquiry. They ought to have an inquiry, as it was the only way in which they could satisfy the public. The Provost said that Mr. Stirling, the Chief Constable, had made an inquiry, in case of any of the injuries proving fatal. The Clerk said that Mr. Stirling could take no action unless he found any malicious conduct in connection with the matter. Mr. Stirling said he had found nothing whatever of that nature. Mr. Christie said he did not want to press the matter; but he would insist upon its being gone into. Mr. Craik said that the damaged retort-bench would not be touched until Mr. Waddell was able to go about; and the Corporation would then be called, and they could get the Board of Trade or any other person to make an inquiry.

The small town of Fort William, which lies near the base of Ben Nevis, is unable to support a gas company; yet the Police Commissioners are arranging for the introduction of a supply of electricity for lighting. The gas supply has, on more than one occasion this year, almost entirely failed; the reason being, as Mr. Fullarton, the Manager of the works, explained at a public meeting, that the works are too small. The natural remedy would be to enlarge them; but the alternative course has been adopted of taking on electricity. The power for driving the machinery is to be derived from water, which will do well enough in summer, when the light is not wanted; but in winter, when it is required in a frosty region like Fort William, there may be difficulties. A reserve steam plant will then be needed; and the community will be in a worse position than now. They are, however, going into the business with their eyes open; and they will therefore have only themselves to blame if they have to pay sweetly for their folly.

Dorking Water Supply.—The Dorking District Council have resolved that new water-works are necessary, and that it will not be in the interests of the ratepayers to acquire the undertaking of the Dorking Water Company at the valuation likely to be put on the existing works. A Committee has been appointed to consider the details of a scheme for constructing the proposed works.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 23.

Sulphate of Ammonia.—Notwithstanding the quiet appearance of the market, there has been a considerable amount of business doing—any parcels offering being readily picked up. Although very little advance in prices has been realized, makers are firm; it being believed that large speculative contracts have yet to be covered. The closing quotations are £8 15s. to £8 16s. 3d. f.o.b. at the ports. In the forward position, speculators are again offering more freely; but it does not transpire whether much business has been done. It is reported that £9 5s. has been refused f.o.b. Leith, over spring months.

Nitrate of Soda is quiet at 7s. 9d. per cwt. on spot.

LONDON, *Nov.* 23

Tar Products.—Pitch is undoubtedly easier; but whether this arises from an effort on the part of buyers to reduce prices, or from natural causes, cannot at the moment be said. The fact remains that makers hold no stocks, and are invariably well sold forward. Carbolic acid is stronger; and the absence of stocks either in the hands of makers or users is likely to accentuate the value of this product in all its forms—crystals being quoted quite ¼d. higher. Anthracene continues firm. Large business is reported; and very little is being offered—most makes outside the Committee having been bought up. Slightly higher prices are being asked for "B" quality. Benzol more than maintains the advance it obtained more than a week ago. No important new business is reported; but very few producers have any for sale for early delivery. Solvent naphtha is steady; and a good trade is being done in naphthalene. Business has been reported during the week at the following rates: Tar, 19s. 6d. to 23s. 6d. Pitch, 35s., west coast; 38s., east coast. Benzols, 90's, 1s. 8d.; 50's, 1s. 7d. Solvent naphtha, 1s. 3½d. Toluol, 1s. 9d. Crude, 30 per cent., naphtha, 5½d. Naphthalene, pressed, 50s.; drained, 30s. Cresylic acid, 1s. 2d.; crude, 9d. Carbolic acid, 60's, 1s. 8d.; 75's, 2s. 1d. Anthracene, "A," 1s.; "B," 10d. All these prices are subject to 2½ per cent. discount.

Sulphate of Ammonia, though in fairly good request, and being shipped in very considerable quantities, has not so far realized anticipations in respect to an improvement in price, although buyers are willing to pay 5s. in advance for forward delivery. Prices, however, are miserably low; and makers would be unwise to sell far forward at such rates. Transactions have been noted at prices ranging between £8 12s. 6d. and £8 15s., less 3½ per cent. at all ports. For forward delivery, 5s. is offered, and 10s. asked, in advance. Gas liquor is quoted at 7s. to 8s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Only a slow, dragging sort of business continues to be reported generally throughout the coal trade, with a good many collieries not working full time, and supplies of all descriptions of fuel plentiful. For the better qualities of round coal, prices are maintained at about list rates, averaging 10s. 6d. per ton for best Wigan Arley; 9s. to 9s. 6d., for Pemberton four-feet and seconds Arley; and 7s. to 7s. 6d., for common house-fire coals. The lower qualities of round coal, for iron-making, steam, and general manufacturing purposes, continue more or less a drug upon the market; and notwithstanding increased activity in the iron-making, engineering, and other industries, requirements for consumption are still a long way below the output of the collieries, and excessively low figures are quoted to clear away surplus supplies in anything like quantities. At the pit mouth, common round coals can be bought from as low as 5s. 6d. per ton for special sales, with ordinary pit prices averaging 6s. to 6s. 6d. Engine classes of fuel are in fair demand so far as the better qualities of slack are concerned; but commoner sorts are a drug, and very low in price. At the pit, best slack fetches from 4s. 6d. up to 5s. per ton, with common sorts obtainable at from 3s. to 3s. 6d. The shipping trade still shows no improvement; and common steam coal can be readily bought at from 7s. to 7s. 6d. per ton delivered at the ports on the Mersey.

Northern Coal Trade.—Very great dulness has been felt in the steam coal trade of the North of England the last few days. The close of the Baltic season usually sees such dulness; but the strikes of last year and its two predecessors gave an alternative demand which does not show itself this year, so that work is short at most of the collieries, and prices are weak. Nominally, best Northumbrian steam coals are quoted at 8s. per ton f.o.b.; and one colliery, which has a command of some French markets, asks 8s. 3d. Much of the coal is, however, sold below the first-named price, either by discount or the acceptance of a slight reduction. Second-class steam coals are quoted at 7s. 3d. to 7s. 6d. per ton f.o.b.; and small steam coals vary from 3s. 9d. to 4s. There have been more contracts entered into for manufacturing coals, chiefly at prices similar to those expiring; but none of the locomotive coal contracts have yet been allotted, and in their cases lower prices than those now current will be taken for next year. Gas coals are now nearly at the height of their demand; and for odd cargoes the price may be said to be slightly higher—from 6s. 9d. to 7s. 3d. per ton being the general rate; but the bulk of the deliveries that are now being made are on contracts taken months ago, and probably generally ranging from 6s. to 6s. 3d. per ton f.o.b. Some of the best gas coal collieries have orders that will ensure full work for at least three months ahead. There is little alteration in the coke trade. The export demand for blast furnace coke is slightly less, owing to the close of the Baltic shipments; but there is a larger local consumption than has been known, and fair quantities are being sent to the north-western blast furnaces. The price for best Durham coke is 14s. 6d. to 15s. per ton f.o.b. With a large production of gas coke, the demand seems also good; so that there is not generally any large addition to the stocks in hand at the gas-works—at least to those near navigable waters.

Scotch Coal Trade.—While the engineers' dispute exists, the coal trade continues to drag. There is really no change to record, either in demand or prices. Supplies are very abundant; the men working all the time they can. The prices quoted are: Main, 5s. 9d. to 5s. 10d. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s.; splint, 6s. 6d. to 6s. 9d.; and steam, 7s. 6d. to 7s. 9d. The shipments for the week amounted to 146,886 tons—a decrease on the preceding week of 14,880 tons, and as compared with the corresponding week of last year of 1217 tons. For the year to date, the total shipments have amounted to 6,575,688 tons—an increase over the corresponding period of last year of 2,071,381 tons, but a decrease as compared with 1893 of 541,209 tons.

Loans for the Merthyr New Water-Works.—At a special meeting of the Merthyr District Council on Monday last week, it was agreed to accept an offer from the Lords of the Admiralty of £132,300 for fifty years and £10,900 for thirty years, at 3½ per cent., for water-works purposes; the money to be repaid on the annuity system half-yearly. It was proposed that the loans should be cleared off by the repayment of principal and interest; but this was rejected by a large majority.

Projected Sewage Disposal Works for Alton (Hants).—An inquiry on behalf of the Local Government Board was held at Alton, Hants, on the 19th inst., by Colonel Coke, M.Inst.C.E., for the purpose of considering an application from the Urban District Council for a loan of about £11,000 for sewage disposal works, the plans for which had been prepared by Messrs. R. B. Grantham and Son, of Northumberland Avenue. The Inspector first examined the land up to and upon which the sewage was to be pumped and distributed, and then held the inquiry. There was a good deal of opposition to the application.

New Joint-Stock Companies.—The Bedworth Gas and Coke Company, Limited, has been registered with a capital of £5000, in 456 £7 ordinary and 904 £2 preference shares, to acquire and carry on the undertaking of the Bedworth Gas and Coke Company. The Dedham Gas Company, Limited, with a capital of £2000, in £2 10s. shares, is to acquire and carry on the business of the Dedham Gaslight, Coke, and Coal Company, Limited. The Harpenden Water Company, Limited, with a capital of £9000, in £5 shares, is to supply the parish of Harpenden in Hertfordshire, and the neighbourhood, with water. The Hot Water Supply Syndicate, Limited, with a capital of £6000, in £1 shares, is to acquire a patent (No. 19,695, dated Oct. 19, 1895) granted to H. M. Robinson, for improvements in apparatus for supplying hot water in exchange for coins or otherwise.

The New Water Supply for Belper.—Messrs. G. and F. W. Hodson, of Loughborough, have prepared a new scheme of water supply for Belper; and their report has been considered by the District Council. The Engineers propose to provide a supply for the whole parish, with mains in all the populous parts, at an entire cost of £15,776. Some of the members of the Council thought the cost heavy, and the scheme too comprehensive. Mr. G. Hodson, however, assured them that they would not go on with any work until they had proved the water they were boring for; and he had no hesitation in advising that the boring be proceeded with. After this, tenders for the boring operations were opened. The lowest was that of Mr. J. F. Price, of Nottingham, at £3054 15s.; and this was accepted. It may be remembered that Mr. H. Strutt, the Chairman of the Council (whose father presented the town with the whole property of the Water Company), has placed at the disposal of the authority the necessary land for the borings, and guaranteed £4000 for carrying out the experiments.

The Gas Question in Liverpool.—The subject of the gas supply of Liverpool is still engaging the attention of the Corporation authorities. At the last meeting of the Lighting Committee of the Council, it was moved that the Council be recommended to rescind the following resolution of the 2nd of October last: "That, in view of the high price paid for coal, &c., used by the Liverpool United Gaslight Company, and the consequent high price of gas and coke, the Town Clerk be, and he is hereby, instructed to do all that is necessary to enable the Council to promote a Bill, in the forthcoming session of Parliament, to obtain powers to establish and maintain a competitive gas supply, and that Standing Order No. 61 be suspended accordingly." On a division, the motion was carried by 11 votes to 3. It was thereupon moved—"That a Special Sub-Committee of five be appointed to consider all matters connected with the supply of gas to Liverpool, and the candle power and charges for the same, with power to discuss the matter with the Gas Company, and to engage, if necessary, a gas expert to advise the Sub-Committee." On a division, nine voted for, and four against the motion. It was therefore carried. When the constitution of the Sub-Committee was under consideration, Alderman F. Smith was proposed as a member; but, on a division, the proposition was lost.

Explosions of Domestic Boilers.—The following circular letter, calling attention to the necessity for adopting precautions against the explosion of domestic boilers during periods of severe frost, has been addressed by the Board of Trade to the various water companies and the local authorities who undertake the supply of water: "The attention of the Board of Trade has from time to time been called to the large number of explosions which have occurred during periods of severe frost from boilers used for domestic purposes. As these boilers are exempt from the provisions of the Boiler Explosions Act, the Board are not in possession of precise information with regard to such casualties; but it is generally agreed that, in the great majority of cases, the explosions are due to the freezing of the water in some portion of the pipes connected with the boiler, and to the excessive pressure thereby caused. The Board are advised that most of these casualties might be prevented by the adoption of simple precautions either to prevent the freezing of the water in the pipes, or to relieve any excess of pressure which may arise in the event of the water becoming frozen. Seeing that many very serious, and a considerable number of fatal, accidents are occasioned by explosions from domestic boilers, and that the number of these casualties might be materially reduced if, before the approach of winter, householders were made aware of the precautions that should be taken, the Board of Trade desire to impress upon water companies and upon local authorities who have undertaken the water supply in their districts the expediency of calling the attention of their customers and ratepayers to the subject, and of placing before them a concise statement of the safeguards that should be adopted. The Board of Trade will be glad to know what steps you propose to take in the matter."

Chertsey Gas Company.—The shareholders of this Company have passed a resolution authorizing the increase of the capital by £4000, by the issue of 160 new ordinary shares of £25 each.

The Proposed Purchase of the Driffield Gas-Works by the District Council.—The members of the Driffield District Council had before them a short time ago an agreement, which had been drawn up conjointly by their own Solicitor and the Solicitor for the Gas Company, for the purchase of the gas-works. It was moved that the agreement should be approved, and the seal of the Council affixed thereto. Some of the members objected to such a serious step being taken, as neither the Council nor the ratepayers had had time to consider the agreement; but the motion was carried by five votes to four. It was resolved to forthwith apply for a Provisional Order.

The Cost of the East London Water Inquiry.—The total cost of the recent inquiry held by the Local Government Board regarding the water supply of East London, so far as the Vestries are concerned, amounts to £624. As is usual in such cases, there is considerable reluctance on the part of the various Boards to settle proportionately; for it is one thing to enter a fight, and another to accept the consequences. As it is, the Hackney Vestry have resolved to pay the whole of the expenses incurred, and have apportioned the same as follows on the several authorities interested in the inquiry: Hackney, £140; Bethnal Green, £88; Mile End, £75; St. George's-in-the-East, £30; Shoreditch, £84; Limehouse, £39; Poplar, £117; Whitechapel, £51.

The Wells City Council and the Gas-Works.—At a meeting of the Wells City Council last Tuesday, the Sanitary Committee reported, as the result of their negotiations with the Gas Company, that they had offered the works to the Council for £19,680, which they considered quite out of the question; and the Committee were prepared to recommend the Council to give a sum of £12,700, which they thought was the value of the undertaking. This the Company had declined to accept; and as they suggested no alternative, nor accepted the offer to light the city, negotiations, as far as the Committee were concerned, were at an end. It was then formally resolved to apply to the Board of Trade for a Provisional Order to light the city by electricity; a proposition to offer the Gas Company £15,000 for their concern being rejected.

Gas Exhibition at Derby.—An exhibition of gas-stoves, grates, and every kind of gas cooking appliances manufactured by Messrs. Richmond and Co., Limited, was opened by the Mayor of Derby (Mr. H. Boam, J.P.), at the Temperance Hall in that town last Tuesday afternoon. He said he was pleased he had been afforded the opportunity of opening the exhibition. Some people had expressed an opinion that gas would soon take a back place; but he had no fear of that. He was glad to say he was a considerable shareholder in the Derby Gas Company, and was not at all fearful of losing his interest. He thought electricity would make greater strides than it had done; and so also would gas, which would be as great a servant of the public in the future as it had been in the past. A vote of thanks to the Mayor having been proposed, Mr. E. W. T. Richmond supported it, saying that the success of the two exhibitions previously held in Derby had led his firm to hold this. He added that, during the exhibition instruction in the management of gas appliances would be given; as well as cookery lectures by Miss Richmond.

Water Scheme for Penrith.—After a controversy extending over four years, the Urban District Council of Penrith have, in Committee, agreed to a scheme for a new water supply to the town, which is expected to cost over £20,000. Local public opinion has been sharply divided from the first between securing a supply by gravitation from Cross Fell, in the neighbourhood of Melmerby, and retaining the present system of pumping from the River Eamont, which flows from Ullswater Lake. The Local Government Board some time ago intimated that, owing to the liability of the stream to pollution, no money would be lent for the improvement of the existing works. It is claimed for the Melmerby plan that the supply from one group of springs alone is three times as great as Penrith needs, although the Local Authority sell large quantities to the Railway Companies. Moreover, it is far beyond the range of cultivation or human habitation; and the analyses are excellent. The last Council election was fought on this question; and three members who then secured seats were not committed to any fixed policy until further investigations had been made. These have now declared for gravitation from Melmerby.

Lamp Explosions at the Salisbury Workhouse.—Owing to the frequency of explosions of the hand-lamps used in the Salisbury Workhouse, the Clerk to the Guardians communicated with the Gas Company, asking if the Directors would supply gas to the workhouse. He received an answer to the effect that, if the workhouse were within the limit of the Company's radius, they would do so. A subsequent letter from the Secretary, however, pointed out that the Company's Act did not extend to Britford, in which parish the workhouse is situated. The Directors, with a view to meeting the wishes of the Guardians, suggested that the difficulty might be got over by laying the mains so far as their limit, and placing a meter at that point, from which the Guardians could carry the pipes to the workhouse. The cost of laying the whole main, it was estimated, would amount to £100. The matter came before the Guardians at their meeting last Friday, when one of the members asked if the House Committee had not exceeded their instructions in going into the whole question of lighting by gas. Mr. Hammick, as Chairman of the Committee, explained that, owing to the explosion of several lamps, it was a question of urgency. The new lamps which were the cause of so much mischief had been purchased with the approval of a Poor Law Board Inspector, and superseded a set of glass lamps formerly in use, with which no mishap had occurred. They had also considered whether the old glass lamps should again be resorted to, or whether candles should be substituted for oil. After some discussion, in the course of which the idea of taking gas to the workhouse was abandoned, on the ground of its great expense (it being estimated that it would cost £400), the porter was called in, and stated that, out of the five dozen small lamps obtained a short time ago by the Guardians, no less than a dozen and a half had exploded. It was decided to dispense with the present kind of lamp; and the matter was left with the Committee.

Destructive Fire at Messrs. Crompton's Works.—Last Friday morning, shortly before nine o'clock, the large electrical plant works of Messrs. Crompton and Co., Limited, at Chelmsford, caught fire, and before noon the premises were almost entirely burnt to the ground. According to the *Suffolk Chronicle*, the first indication of anything amiss was smoke coming from the high-tension switch-board. Evidently the switch had become overheated, or at least some part of it, and thus caused the mischief. Before the alarm had barely been given, the flames seemed to have taken hold of the entire engine-room. The quickness with which they spread may be judged from the fact that the employees were unable to get their own hand hose into play. From the engine-room, the flames spread east and west; and in turn the store-room, the general offices, the drawing offices, and the main workshop were a mass of fire. In two hours this had nearly done its work; most of the buildings being completely gutted, and their contents destroyed. The damage is estimated at £100,000; and as the works contained the machinery for the electric lighting of the town, this will necessarily be interrupted.

Sales of Shares.—At the Mart, Tokenhouse Yard, last Wednesday, Messrs. Fox and Bousfield sold parts of freehold shares in the *New River Company* at the rates of £101,000, £108,000, and £119,000 per share; also new shares (£100) at £400 each.——On the previous day, Messrs. Edwards and Son sold £5000 of stock of the *Staffordshire Potteries Water Company* at prices ranging from £119 to £121 per £100 lot.——Last Wednesday, £1500 new "A" stock in the *Canterbury Gas and Water Company* was offered for public competition in 150 lots of £10 each, being part of an authorized issue of £36,000. The lots fetched an average of £23 2s. 3d. each.——Last Thursday, Messrs. Alexander, Daniel, Selfe, and Co. sold by auction, at Bristol, £15,000 of 7 per cent. maximum consolidated ordinary stock in the *Bristol Water-Works Company*. The total amount realized was £22,217 10s., or an average of £148 2s. 3d. per cent. There was a large attendance; and the bidding was spirited.——At the Mart, last Friday, Messrs. J. A. and W. Tharp sold 155 £5 and 107 £10 shares in the *West Ham Gas Company*. The former fetched from £11 15s. to £12 per share, realizing £1832; and the latter, £14 10s. to £15 per share, realizing £1592.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1080.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	10	23–24	+½	4 7 6
100,000	10	,,	7½	Do. 7 p. c.	10	16½–17½	..	4 5 8
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	107–109	..	4 11 9
200,000	5	14 Nov.	6½	Bombay, Limited	5	6¼–7¼*	–¼	4 9 8
40,000	5	,,	6½	Do. New	4	5–5⅛*	..	4 14 7
380,000	Stck.	14 Aug.	12	Brentford Consolidated	100	253–258	..	4 13 0
180,000	,,	,,	9	Do. New	100	205–210	..	4 5 8
220,000	Stck.	27 Sept.	11	Brighton & Hove Original	100	227–232	..	4 14 10
933,500	Stck.	29 Aug.	5	Bristol	100	124–128	–1½	3 18 1
320,000	20	27 Sept.	11½	British	20	54½–55½	..	4 1 1
50,000	10	29 Aug.	11½	Bromley, Ordinary 10 p. c.	10	22½–23½	..	4 17 10
51,510	10	,,	8½	Do. 7 p. c.	10	18½–19½	..	4 7 2
328,750	10	14 Nov.	4	Buenos Ayres (New) Limited	10	8–8½*	..	4 14 1
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	102–104	..	5 15 5
150,000	20	11 July	8½	Cagliari, Limited	20	31–33	..	5 0 0
550,000	Stck.	26 Oct.	13½	Commercial, Old Stock	100	320–325	..	4 3 1
165,000	,,	,,	10½	Do. New do.	100	247–252	..	4 3 4
160,762	,,	12 June	4½	Do. 4½ p. c. Deb. do.	100	143–147	..	3 1 3
800,000	Stck.	12 June	13	Continental Union, Limited	100	278–283	..	4 11 10
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	215–220	..	4 11 10
535,000	Stck.	29 Aug.	5½	Crystal Palace Ord. 5 p. c. Stk	100	125–130	..	4 0 9
486,090	10	26 July	11	European, Limited	10	25½–26½	..	4 3 0
354,060	10	,,	11	Do. Partly paid	7½	17–18	..	4 14 3
5,646,590	Stck.	14 Aug.	12½	Gaslight & Coke, A, Ordinary	100	292–296	–4	4 6 2
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	107–112	..	3 11 5
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	284–288	..	3 9 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	135–140	..	3 11 5
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	200–205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	193–198	..	3 10 9
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	282–287	..	3 9 8
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	167–170	..	3 10 7
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	100	135–140	..	2 17 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	147–152	..	2 19 2
908,000	,,	,,	6	Do. 6 p. c. do.	100	202–207	..	2 17 11
3,800,000	Stck.	14 Nov.	12	Imperial Continental	100	235–240*	–2	5 0 0
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	6–6¼	..	4 12 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p.c. Deb.	100	113–116	..	4 6 2
541,920	20	14 Nov.	5	Monte Video, Limited	20	17–18*	..	5 11 2
150,000	5	24 May	8	Oriental, Limited	5	7½–8	..	5 0 0
60,000	5	12 Sept.	7	Ottoman, Limited	5	5–5½	..	6 7 3
166,870	10	14 Feb.	2	Para, Limited	10	1½–2½	..	8 0 0
420,000	100	2 Nov.	6	People's Gas of Chicago—1st Mtg. Bds.	100	105–110	..	5 9 1
500,000	100	4 June	6	2nd Do.	100	102–107	..	5 12 1
150,000	10	16 Oct.	7	San Paulo, Limited	10	11–12	..	5 16 8
500,000	Stck.	29 Aug.	15½	South Metropolitan, A Stock	100	370–375	..	4 2 8
1,350,000	,,	,,	12	Do. B do.	100	308–313	..	3 16 8
308,685	,,	,,	13	Do. C do.	100	325–330	..	3 18 9
800,000	,,	11 July	5	Do. 5 p. c. Deb. Stk.	100	175–178	..	2 16 2
60,000	Stck.	12 Sept.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	26 June	10	Chelsea, Ordinary	100	295–300	..	3 6 8
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	100	218–223	–2	3 2 8
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	100	157–162	..	2 15 6
700,000	50	26 June	6½†	Grand Junction	50	110–115	–¾	2 16 6
708,000	Stck.	29 Aug.	12	Kent	100	307–312	–¾	3 16 11
1,043,800	100	26 June	7½†	Lambeth, 10 p. c. max.	100	249–254	..	2 17 1
406,200	100	,,	7½†	Do. 7½ p. c. max.	100	208–213	..	3 8 1
330,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	100	143–148	..	2 14 2
500,000	100	14 Aug.	12½	New River, New Shares	100	380–390	..	3 3 7
1,000,000	Stck.	26 July	4	Do. 4 p. c. Deb. Stk.	100	143–148	..	2 14 2
902,300	Stck.	12 June	4	S'thwk & V'xhall, 10 p.c. max.	100	145–150	–1	2 13 4
126,500	100	,,	4	Do. D 7½ p. c. do.	100	140–145	..	2 15 2
1,155,066	Stck.	12 June	10	West Middlesex	100	293–298	..	3 7 1

*Ex div

† Next dividend will be at this rate.

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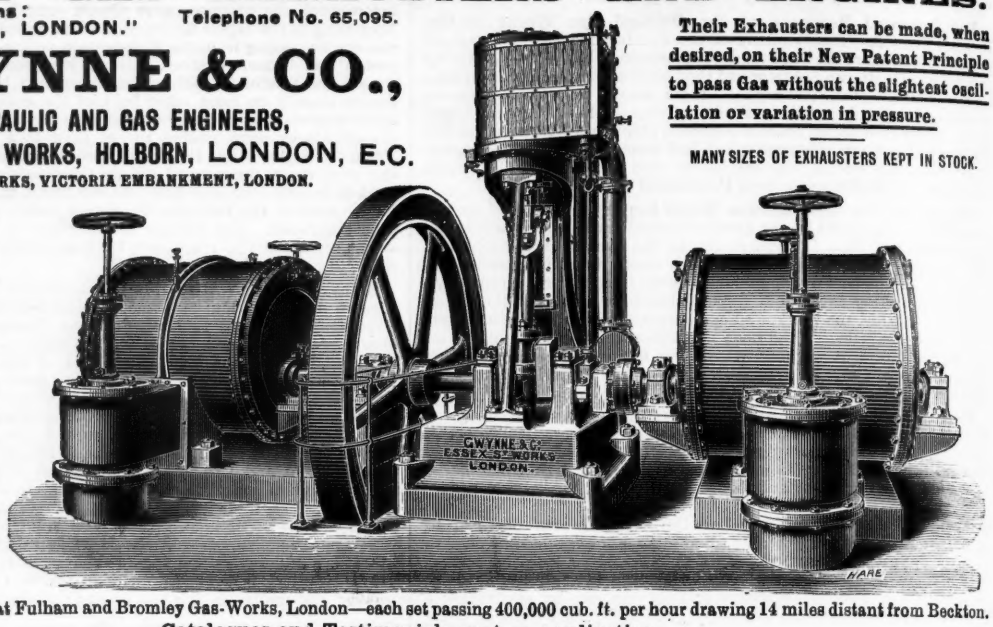

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THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

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Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.
*** See Advertisement p. 1070 of this week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1759.

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.
Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 315, St. Vincent Street, GLASGOW; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality.
Sample and Price on application.
OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER LINCOLN."

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

THE Undersigned is in a position to supply, at the very lowest Prices, the most suitable kind of BENZOL for enriching Gas, made from Hardman's Patent Carbonization Process, of which I am the Sole Patentee. On application, I would furnish Price on the most reasonable terms; giving advice how to utilize it on the most economical method.
J. HARDMAN, Manufacturing Chemist.
Milton, Staffs.

It is Worth Your While to Buy DIRECT.
THE RELIANCE LUBRICATING OIL COMPANY will SUPPLY on APPROVAL 40-gallon Barrels "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Solid and Liquid Lubricants for all other purposes.
RELIANCE LUBRICATING OIL COMPANY,
19 & 21, WATER LANE, GREAT TOWER STREET, LONDON, E.C.

WANTED, immediately, a Working MANAGER for the Bryncelyn Gas-Works, Pontardawe, near Swansea. He must be a good Fitter, and capable of fitting up Houses throughout. Help given when required. Wages, 30s. per week inclusive.
Apply to ROBT. ALEX. BROWNING, Gas-Works, NEATH.

ASSISTANT SECRETARY OR ASSISTANT MANAGER.

ADVERTISER (35), with Twenty Years' continuous record for steadiness and energy, desires an ENGAGEMENT of the above nature. Gas and Water Business Management and Accounts thoroughly understood. Populous district. Total Abstainer. Science and Art Certificates.

Applications invited to No. 2602, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a young active Man to take sole charge of a Country Gas-Works, making about 2½ millions. Must be thoroughly trustworthy, and up to date in Gas Making. One capable of Retort Setting, Main Laying, and Gas-Fitting preferred.

Apply, stating Wages (House, Gas, and Coal found), to H. MUSSINGHAM, Ear's Colne, ESSEX.

METER INSPECTOR wanted for Gas- Works in Midlands. Must have some knowledge of Fittings and Stoves. Wages, 28s. per week to commence. Good References required.

Address, stating Age, &c., and enclosing References, No. 2608, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, at once, an Active Young Man as PLUMBER and MAIN and SERVICE LAYER (Gas and Water). Must be able to wipe Joints, read Meters, and competent to act as Water Inspector. Wages to commence, 26s. per week.

Apply, with *copies* of Testimonials, in the first instance, to the MANAGER, Water and Gas Company, BEXHILL.

WANTED, a Secretary who thoroughly understands the business of a Gas Engineering Establishment, and must be a good Accountant and Correspondent, and, if required, be able to Travel. Salary, £130 per annum.

Applications, with References, stating Age and Experience, to be sent to No. 2601, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SINGAPORE GAS COMPANY, LIMITED.

WANTED, a fully qualified Gas En- gineer to take over the duties of MANAGER and LOCAL SECRETARY of the above Company in March next (leaving England about the 1st of February). Salary, $400 a month, with good Residence and other Allowances, including First-Class Passage for himself and wife. Three years' engagement.

Applications, stating Age (which must be under 40), Qualifications, together with not more than three recent Testimonials, should be forwarded by Wednesday, the 11th of December, to the undersigned, from whom all particulars can be obtained.

ROBERT M. CHRISTIE,
Secretary.

98, Cannon Street, E.C.

THE Directors of the Berwick and Tweedmouth Gaslight Company, Limited, require a competent WORKING MANAGER for their Works. He must have had experience with Regenerative Settings of Retorts, and understand the Testing of Gas and the general routine of a Gas-Works. The person appointed will require to reside at the Works, where an excellent House, together with Coal and Gas, will be provided free.

Applications, stating Age, Salary required, when at liberty, and enclosing not more than three *copies* of recent Testimonials, must be delivered to the undersigned not later than the 28th of November.

T. G. TURNER,
Secretary.

37, High Street, Berwick-on-Tweed.

FOR SALE, by Private Treaty—The BREWOOD GAS-WORKS (Staffs.), Two miles from Four Ashes Station on the L. & N.W.R., Seven Miles from Wolverhampton, comprising COTTAGE, OFFICE, GASHOLDER, RETORT-HOUSE, PURIFYING-HOUSE, CONDENSERS, STEAM-ENGINE, and EXHAUSTER, all enclosed and comprising 2166 square yards. Freehold, with Canal Frontage. The Works are in full Working Order, supplying upwards of 695,000 cubic feet of Gas per Annum; and the consumption, with energetic management, can be largely increased.

Can be seen by appointment, and further Particulars had from

LAURENCE W. BOURNE,
Auctioneer, Valuer, &c.

104, Colmore Row, Birmingham.

TO TAR DISTILLERS.

THE Directors of the Shotley Bridge and Consett District Gas Company invite TENDERS for the purchase of the TAR produced at their Works for the Year 1896.

Quantity, about 60,000 gallons.

Contractor to provide Casks, and accept delivery at Consett and Blackhill Station.

Tenders to be sent to the undersigned not later than Dec. 12.

M. RICHLEY,
Secretary.

SULPHURIC ACID.

THE Directors of the Tynemouth Gas Company are prepared to receive TENDERS for the supply of SULPHURIC ACID required during One or Two Years, from Jan. 1, 1896.

Quantity per annum, 200 Tons.

Particulars from the undersigned, to whom sealed tenders should be forwarded on or before Monday, Dec. 2.

The Directors do not agree to accept the lowest or any tender.

W. HARDIE, Jun.,
Engineer.

Gas-Works, North Shields,
November, 1895.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the supply of Four PURIFIERS, each 36 ft. by 27 ft., complete with Valves and Connections.

Specifications may be seen, and Forms of Tender obtained, on application to Mr. Thomas Holgate, Gas-Works Engineer, Halifax.

Tenders, endorsed "Tender for Purifiers," must be sent to the undersigned on or before the 4th of December, 1895.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
KEIGHLEY WALTON,
Town Clerk.

CORPORATION OF LEICESTER.

RETORTS AND FIRE-BRICKS.

THE Gas and Electric Lighting Com- mittee of the above Corporation are prepared to receive TENDERS for the supply and delivery of RETORTS and FIRE-BRICKS.

Specification, Quantities, and Form of Tender can be obtained from the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Dec. 7, 1895.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, Nov. 14, 1895

CORPORATION OF LEICESTER.

CAST-IRON PIPE CONTRACT.

THE Gas and Electric Lighting Com- mittee of the above Corporation are prepared to receive TENDERS for the supply and delivery of the necessary CAST-IRON PIPES and CONNECTIONS, from 2 inches to 24 inches in diameter, required during the Twelve Months ending the 31st of December, 1896.

Specification and Form of Tender to be obtained from the Engineer.

Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Cast-Iron Pipes, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Dec. 7, 1895.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.

Offices: Millstone Lane,
Leicester, Nov. 14, 1895.

BOROUGH OF HEYWOOD.

THE Gas Committee invite Tenders for the supply of FIRE-CLAY GOODS.

Specifications and Form of Tender may be obtained upon application to Mr. W. Whatmough, Gas Manager.

Contractors tendering for this work must pay their workpeople at least the Standard or Trade Union rate of Wages, and observe the Trade Conditions which attach to the various kinds of work for which the tender is sent in.

Tenders, endorsed "Fire-Clay Goods," to be sent to me not later than Tuesday, the 17th day of December, 1895.

By order,
A. B. PILLING,
Town Clerk.

Municipal Buildings, Heywood,
Nov. 13, 1895.

SOUTHAMPTON GASLIGHT & COKE COMPANY.

ISSUE OF 5 PER CENT. DEBENTURE STOCK.
SALE BY TENDER.
MINIMUM PRICE, £150 PER CENT.

THE Directors invite Tenders for £5000 of DEBENTURE STOCK, authorized to be raised under the Southampton Gas Act, 1876, which will bear a fixed and Perpetual Preferential Rate of Interest of Five Pounds per cent. per annum, payable Half Yearly (subject to Income-Tax).

Allotments to the highest bidders.

Tenders must be delivered on or before Saturday, the 14th of December, 1895.

Forms of Tender, with Particulars and Conditions, may be obtained on application, from the Secretary, at the Company's Offices, Ogle Road, Southampton, or from the Company's Bankers, Messrs. Grant and Maddison's Union Banking Company, Limited, Southampton, or from Messrs. Lloyd's Bank, Limited, Lombard Street, London.

By order of the Directors,
C. CROWTHER SMITH,
Secretary.

Southampton,
Nov. 20, 1895.

BROMLEY GAS CONSUMERS' COMPANY.

SALE BY AUCTION OF 399 ORDINARY SHARES OF £10 EACH.

THE Directors give Notice that they have instructed Messrs. Baxter, Payne, and Lepper to SELL BY AUCTION, at the Bell Hotel, Bromley, Kent, on Thursday, the 12th of December, 1895, at Eight o'clock p.m. precisely, 399 ORDINARY SHARES of £10 each, in the Bromley Gas Consumers' Company, in lots of Five and Ten Shares each, and one lot of Nine Shares.

The Dividend paid upon this class of Shares for the past four years has been at the rate of 8½ per cent. per annum.

Particulars and Conditions of Sale may be obtained of the SECRETARY of the Company; Messrs. WILLETT AND LATTER, Solicitors, Market Square, Bromley, KENT; and of the AUCTIONEERS, Market Square, Bromley, KENT.

By order,
HENRY WILLIAM AMOS,
Secretary.

Bromley, Kent,
Nov. 20, 1895.

CARDIFF GASLIGHT AND COKE COMPANY.
(INCORPORATED MAY 5, 1837.)

THE Directors of the Cardiff Gaslight and Coke Company Hereby Give Notice that they are prepared to receive not later than Ten a.m., Friday, the 13th of December, 1895, sealed TENDERS for

£15,000 "D" STOCK,

bearing a Maximum Dividend of 5 per cent. per annum, in pursuance of the powers of the Cardiff Gas Act, 1887.

Particulars and Conditions of Tender may be obtained on application to the undersigned.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
Nov. 13, 1895.

SOUTH SHIELDS GAS COMPANY.

IMPORTANT SALE OF GAS STOCK.

MR. M. STAINTON is instructed by the Gas Company to SELL BY PUBLIC AUCTION, in the Board-Room, at the Gas Offices, Chapter Row, South Shields, on Monday, the 2nd of December, 1895, at One o'clock p.m., prompt, £10,000 of NEW STOCK under the South Shields Gas Act, 1886.

The Stock will be put up in Lots of £100 each, nominal value. A Deposit of £10 per cent. to be paid on the purchase-money at the Sale; the remainder to be paid on or before the 31st of December next.

If the Purchaser pays the full amount at the time of Sale, he will be entitled to Interest thereon at the rate of 3 per cent. per annum, up to, and payable on, the 31st of December, 1895.

The Stock will be registered in the name of the Purchaser, free of expense.

By order of the Directors,
J. H. PENNEY,
Secretary.

EAST LONDON WATER-WORKS COMPANY.

ISSUE OF £125,000 THREE PER CENT. DEBENTURE STOCK.
MINIMUM PRICE, PAR.

NOTICE is Hereby Given, that the Directors are prepared to receive TENDERS for the above Issue (being the second portion of the £500,000 Debenture Stock, created under the East London Water-Works Company's Act of 1894), bearing Interest at 3 per cent. per annum less Income-Tax, and Redeemable after the expiration of 25 Years from the date of issue, subject to Six Months' Notice being given by the Company.

Minimum price, par.

Tenders must be delivered at the Company's Office, St. Helen's Place, Bishopsgate, E.C., not later than Eleven a.m., on Thursday, the 12th day of December ensuing.

Particulars and Conditions, together with Form of Tender, may be obtained at the said Offices, or will be forwarded on application.

By order of the Court of Directors,
I. A. CROOKENDEN,
Secretary.

St. Helen's Place, Bishopsgate, E.C.,
Nov. 13, 1895.

NOTICES FOR POSTING IN GAS-WORKS.

CARDS suitable for Exhibiting in Gas- Works, directing Officers and Workmen to REPORT all ACCIDENTS witnessed by them, together with the Clause of the "NOTICE OF ACCIDENTS ACT, 1894," specifying the notice required to be sent to the Board of Trade, can be obtained, *price 4d. each, or 2s. 6d. per dozen, post free.*

Section 4 of the "CONSPIRACY AND PROTECTION OF PROPERTY ACT, 1875," has been similarly printed. It is required, under a Penalty of FIVE POUNDS, that a Copy of the Section shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by persons employed thereat. Copies, in large type, on broad sheets (22½ inches by 17½ inches) may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C. *Price 2s. per dozen;* 10s. 6d. *per* 100. On Cards the same size as those relating to the "Notice of Accidents Act," *price 4d. each, or 2s. 6d. per dozen.*

Price 15s., Limp Cloth, the Fifteenth Yearly

ANALYSIS OF THE ACCOUNTS

OF THE

Metropolitan Water Companies,

Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex—showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand Gallons of Water supplied; the proportion of Expenditure and Profits to Gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the Year ended December 31, 1894, or March 31, 1895, together with the quantity of Water supplied, the estimated daily quantity supplied for domestic and other purposes, the quantity supplied per head of population, &c., &c., for the Year ended December 31, 1894.

Compiled and arranged by

ALFRED LASS, F.C.A.

LONDON:
WALTER KING, 11, Bolt Court, Fleet Street, E.C.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

HUNTER'S

OXIDE OF IRON.

JAMES HUNTER, MINER, AND SHIPPER OF

NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "HUNTER, PORT GLASGOW."

Established 1872.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . .	11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.	
Coke (of good & pure quality)	$13\frac{3}{4}$ Cwt. Per Ton.
Sulphur	A little over 1 Per Cent.
Ash	Under 1 Per Cent.
Tar	163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor	103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . .	10,500 Cubic Feet.
Illuminating Power	17 Stand. Sperm Candl.
Coke (of excellent quality)	$13\frac{1}{2}$ Cwt. Per Ton.
Sulphur	1·13 Per Cent.
Ash	1·34 Per Cent.
Tar	180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor	$94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COAL-FIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,

HOLMSIDE AND SOUTH MOOR OFFICES,

NEWCASTLE-UPON-TYNE.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

GAS PURIFICATION.

Best Absorbent of Sulphuretted Hydrogen, &c.

JAMES E. CAMPBELL,

Patentee and Manufacturer,

96, MILL STREET, BRADFORD, MANCHESTER.

PRICES, &C., ON APPLICATION.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·4 candles.
Coke	68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.,

B Lombard Street,

NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.

RAVENSTHORPE, NEAR DEWSBURY.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,

NEWBATTLE COLLIERIES,

DALKEITH, N.B.

NOTICE.

THE METEOR INCANDESCENT LIGHTING COMPANY, Limited, have had their attention called to the advertisements of the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the Meteor Incandescent Gas-Light is an infringement of the Patents of the Incandescent Gas-Light Company, Limited, and that the latter Company is about to commence an Action against the Meteor Company for Infringement.

THE METEOR INCANDESCENT LIGHTING COMPANY, Limited, consequently Hereby Give Notice that they are advised that the Meteor Incandescent Lights in no way infringe any of the patents of the Incandescent Gas-Light Company, Limited, and that they are prepared to INDEMNIFY all Purchasers, Dealers, Agents, and Users of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

An action has this day been commenced to restrain the further issue of such threats.

WILSON, BRISTOWS, & CARPMAEL,

1, Copthall Buildings, E.C.

Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.

Nov. 19, 1895.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that a Firm of F. J. Putz & Co., 16 and 17, Great St. Helen's, London, are advertising for sale Incandescent Gas-Light Apparatus called the "Champion" Incandescent Gas-Burner, and are stating in their circular that such Apparatus may be legally sold throughout the United Kingdom without Infringement of any existing Patent.

This is to Give Notice to the Public and the Trade that Actions for Infringement of Patent and for an Injunction will be immediately commenced by the Incandescent Gas-Light Company, Limited, against any persons using or selling such Apparatus.

The validity of the Company's Patents has already been certified by Mr. Justice Romer; and Solicitor and Client costs will be enforced in all cases.

FAITHFULL & OWEN,

11, Victoria Street, S.W.

Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo,* **Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—**

The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others,* **the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.**

(Signed) FAITHFULL & OWEN,

Solicitors for the Incandescent Gas-Light Company, Limited.

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,

for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

COAL OWNERS, NEWCASTLE-ON-TYNE;

OR

E. FOSTER & CO.,

21, JOHN STREET, ADELPHI, LONDON, W.C.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

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Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
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Specific Gravity (Water 1)	1·276
Weight of One Cubic Foot	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter	35·60 ,,
Fixed Carbon	58·80 ,,
Sulphur	0·96 ,,
Ash	1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal	11,760 cub. feet.
Gas per Cubic Foot of Coal	418 ,,
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm	418 grains.
Value per Ton of Coal in Sperm	703 lbs.
Coke per Ton of Coal	1867 ,,
Coke	61·05 per cent.
Ash in Coke	3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 ,,
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 ,,

R. O. PATERSON, C.E.

Gas-Works, Cheltenham, 8th August, 1894.

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LIMITED,

BARNSLEY;

Or to **Mr. W. H. HARVEY,**

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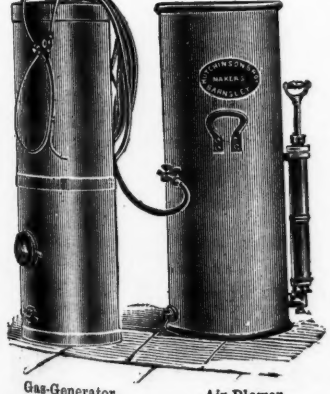

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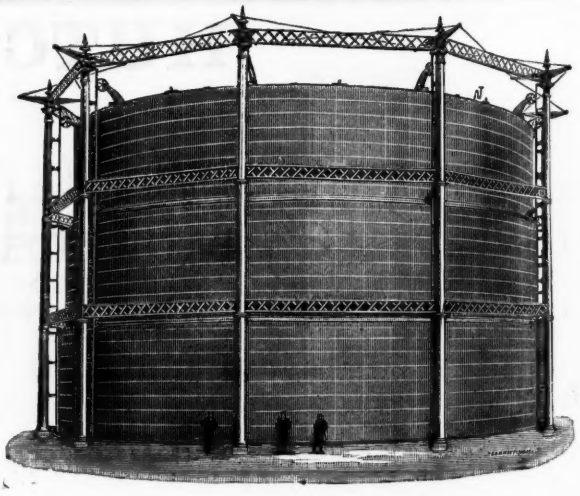

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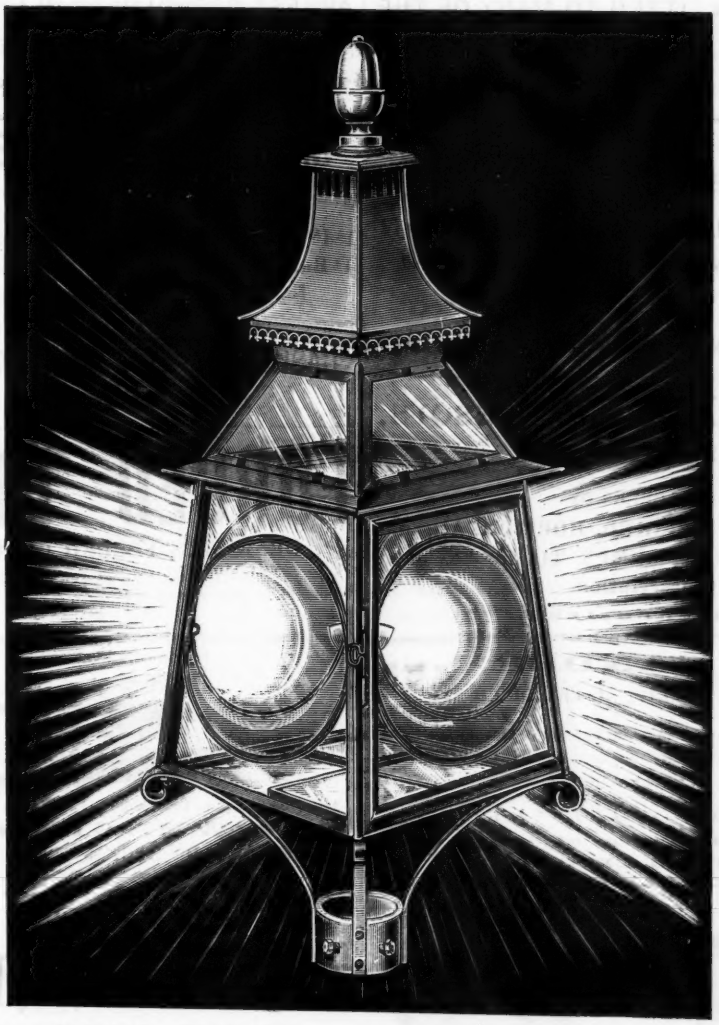

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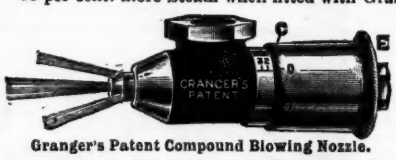

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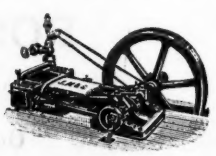

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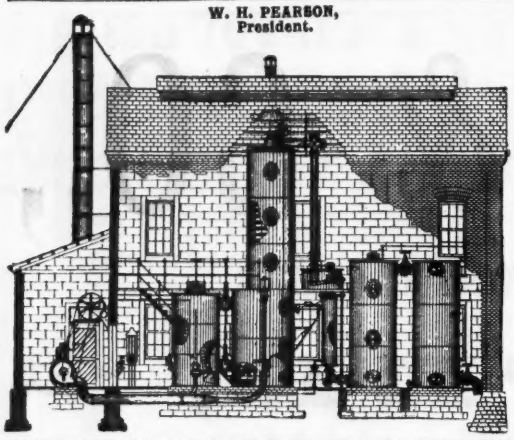

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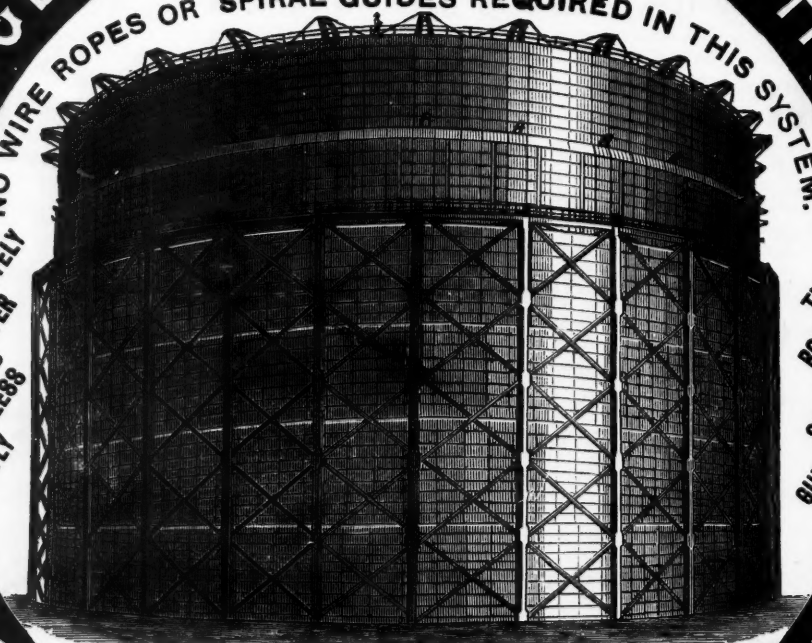

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[See Illustrated Advertisement, Nov. 5, p. 945.]

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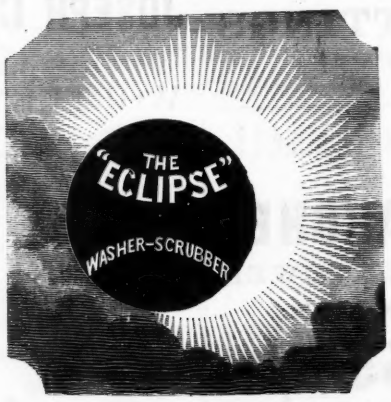

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